UNIVERSAL CYCLOPÆDIA AND ATLAS

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MAPS IN VOL. IV.

POLITICAL.

HISTORICAL AND LINGUISTIC.

PLATES AND FULL-PAGE ILLUSTRATIONS.

PECULIAR PHONETIC SYMBOLS

USED IN THE WRITING OR TRANSLITERATION OF THE DIFFERENT LANGUAGES.

ā, ē, etc.: long vowels; in the Scandinavian languages the accent (*á*, *é*, etc.) is used to denote length.

ą: a nasalized *a*; so used in the transliteration of the Iranian languages.

å: labialized guttural *a* in Swedish.

æ: open *a* of Eng. *hat*, used chiefly in O. Eng.

aí: used in Gothic to denote *e* (open), in distinction from *ái*, the true diphthong.

aú: used in Gothic to denote *o* (open), in distinction from *áu*, the true diphthong.

bh: in Sanskrit a voiced labial aspirate (cf. *ch*).

ƀ: voiced bilabial (or labio-dental?) spirant, used in discussions of Teutonic dialects.

ç: voiceless palatal sibilant, similar to Eng. *sh*, used especially in transliteration of Sanskrit.

č: frequently used, e. g. in Slavonic languages, to denote the sound of Eng. *ch* in *cheek*.

c: voiceless palatal explosive, commonly used in transliteration of Sanskrit and the Iranian languages.

ch: as used in the transliteration of Sanskrit, a voiceless palatal aspirate, an aspirate being an explosive with excess of breath; as used in German grammar, the symbol for a voiceless palatal or guttural spirant.

dh: voiced dental aspirate (cf. *ch*) in Sanskrit.

ḍ: voiced cerebral explosive, so used in transliteration of Sanskrit.

ḍh: voiced cerebral aspirate (cf. *ch*) in Sanskrit.

đ: voiced dental (interdental) spirant, equivalent to Eng. *th* in *then*; so used in the Teutonic and Iranian languages and in phonetic writing.

ë: a short open *e*, used in Teutonic grammar, particularly in writing O. H. G.

ə: the short indefinite or "obscure" vowel of Eng. *gardener*; used in the reconstruction of Indo-Eur. forms, and in transliterating the Iranian languages.

gh: in Sanskrit a voiced guttural aspirate (cf. *ch*).

g: voiced velar (back-guttural) explosive, used most frequently in Indo-Eur. reconstructions.

ʒ: voiced guttural (or palatal) spirant, equivalent to Mod. Greek *γ*, and used in transliteration of Iranian languages and O. Eng.

ḥ: a voiceless breathing, the Sanskrit *visarga*.

ƕ: a labialized *h*, similar to *wh* in Eng. *what*; used in transliteration of Gothic and the Iranian languages.

ḫ: voiceless guttural (or palatal) spirant, equivalent to German *ch*, and used in transliteration of the Iranian languages.

i̯: the semi-vowel *y*, or consonant form of *i*; used in phonetic writing and reconstructions of Indo-Eur. forms.

j: in the transliteration of Sanskrit and the Iranian languages a voiced palatal explosive; in the Teutonic languages a semi-vowel (= *y*), for which in Indo-Eur. reconstructions *i* is generally used.

jh: in Sanskrit a voiced palatal aspirate (cf. *ch*).

kh: in Sanskrit a voiceless guttural aspirate (cf. *ch*).

ł: the guttural ("thick" or "deep") of the Slavonic and some of the Scandinavian languages.

ḷ: vowel *l*; used in transliterating Sanskrit, in reconstructing Indo-Eur. forms, and in other phonetic writing.

n̥: nasal vowel; used in reconstruction of Indo-Eur. forms and in phonetic writing.

ṇ: in Sanskrit the cerebral nasal.

ṅ: in Sanskrit the guttural nasal (see following).

ŋ: the guttural nasal, equivalent to Eng. *n* in *longer*; used in transliteration of Iranian languages.

ñ: palatal nasal, similar to *gn* in Fr. *regner*; used in transliterating Sanskrit and in phonetic writing.

ö: palatalized *o*; used in German and in phonetic writing.

ǫ: short open *o* in Scandinavian.

ø: short palatalized *o* (ö) in Scandinavian.

ph: in Sanskrit, voiceless labial aspirate (cf. *ch*).

ꝗ: voiceless velar (back-guttural) explosive; used in reconstructions of Indo-Eur. forms and in other phonetic writing.

ṛ: vowel *r*; used in transliterating Sanskrit, in reconstructions of Indo-Eur. forms, and in other phonetic writing.

š: voiceless cerebral sibilant, equivalent to Eng. *sh*; used in transliterating the Iranian languages and in phonetic writing.

ṣ: voiceless cerebral spirant; used in transliterating Sanskrit.

th: in Sanskrit a voiceless dental aspirate (cf. *ch*).

ṭh: in Sanskrit a voiceless cerebral aspirate (cf. *ch*).

ṭ: in Sanskrit a voiceless cerebral explosive.

ț: a form of dental spirant used in transliterating the Iranian languages (represented in Justi's transliteration by ṭ).

þ: voiceless dental (interdental) spirant, equivalent to Eng. *th* in *thin*; used in Teutonic dialects and in phonetic writing.

u̯: consonant form of *u*; used in phonetic writing.

ž: voiced cerebral sibilant, equivalent to *s* in Eng. *pleasure*, and to *j* in Fr. *jardin*; used in Iranian, Slavonic, and in phonetic writing.

ʒ: a symbol frequently used in the writing of O. H. G. to indicate a voiced dental sibilant (Eng. *z*), in distinction from *z* as sign of the affricata (*ts*).

EXPLANATION OF THE SIGNS AND ABBREVIATIONS USED IN THE ETYMOLOGIES.

>, yielding by descent, i. e. under the operation of phonetic law.

<, descended from.

=, borrowed without change from.

: , cognate with.

+, a sign joining the constituent elements of a compound.

*, a sign appended to a word the existence of which is *inferred.*

ablat.	ablative
accus.	accusative
adjec.	adjective
adv.	adverb
cf.	compare
conjunc.	conjunction
deriv. of	derivative of
dimin.	diminutive
fem.	feminine
genit.	genitive
imper.	imperative
impf.	imperfect
indic.	indicative
infin.	infinitive
masc.	masculine
nomin.	nominative
partic.	participle
perf.	perfect
plur.	plural
prep.	preposition
pres.	present
pron.	pronoun
sc.	scilicet, supply
sing.	singular
subst.	substantive
vocat.	vocative

Anglo-Fr.	Anglo-French
Arab.	Arabic
Avest.	Avestan
Dan.	Danish
Eng.	English
Fr.	French
Germ.	German
Goth.	Gothic
Gr.	Greek
Heb.	Hebrew
Icel.	Icelandic
Ital.	Italian
Lat.	Latin
Lith.	Lithuanian
Mediæv. Lat.	Mediæval Latin
Mod. Lat.	Modern Latin
M. Eng.	Middle English
M. H. Germ.	Middle High German
O. Bulg.	Old Bulgarian (= Church Slavonic)
O. Eng.	Old English (= Anglo-Saxon)
O. Fr.	Old French
O. Fris.	Old Frisian
O. H. Germ.	Old High German
O. N.	Old Norse
O. Sax.	Old Saxon
Pers.	Persian
Portug.	Portuguese
Prov.	Provençal
Sanskr.	Sanskrit
Sc.	Scotch
Span.	Spanish
Swed.	Swedish
Teuton.	Teutonic

KEY TO THE PRONUNCIATION.

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aa...... as *a* in *father*, and in the second syllable of *armada*.

ăa...... same, but less prolonged, as in the initial syllable of *armada*, *Arditi*, etc.

a....... as final *a* in *armada*, *peninsula*, etc.

ă....... as *a* in *fat*, and *i* in French *fin*.

ay or ā.. as *ay* in *nay*, or as *a* in *fate*.

ay̆ or *ā*.. same, but less prolonged.

ã....... as *a* in *welfare*.

aw...... as *a* in *fall*, *all*.

ee...... as in *meet*, or as *i* in *machine*.

ĕe...... same, but less prolonged, as final *i* in *Arditi*.

e....... as in *men*, *pet*.

e....... obscure *e*, as in *Bigelow*, and final *e* in *Heine*.

ė....... as in *her*, and *eu* in French *-eur*.

i....... as in *it*, *sin*.

ī....... as in *five*, *swine*.

ī....... same, but less prolonged.

ō....... as in *mole*, *sober*.

ō....... same, but less prolonged, as in *sobriety*.

o....... as in *on*, *not*, *pot*.

oo...... as in *fool*, or as *u* in *rule*.

o͝o...... as in *book*, or as *u* in *put*, *pull*.

OI...... as in *noise*, and *oy* in *boy*, or as *eu* in German *Beust*.

ow...... as in *now*, and as *au* in German *haus*.

ö....... as in *Göthe*, and as *eu* in French *neuf*, *Chintreuil*.

ŭ....... as in *but*, *hub*.

ŭ....... obscure *o*, as final *o* in *Compton*.

ü....... as in German *süd*, and as *u* in French *Buzançais*, *vu*.

y or *l*.... see *l* or y.

yu....... as *u* in *mule*.

y̆u....... same, but less prolonged, as in *singular*.

ch....... as in German *ich*.

g........ as in *get*, *give* (never as in gist, congest).

hw...... as *wh* in *which*.

*k*h....... as *ch* in German *nacht*, *g* in German *tag*, *ch* in Scotch *loch*, and *j* in Spanish *Badajos*, etc.

ṅ....... nasal *n*, as in French *fin*, *Bourbon*, and nasal *m*, as in French *nom*, Portuguese *Sam*.

ñ or n-y.. Spanish *ñ*, as in *cañon*, *piñon*, French and Italian *gn*, etc., as in *Boulogne*.

l or y.... French *l*, liquid or mouillé, as (-i)ll- in French *Baudrillart*, and (-i)*l* in *Chintreuil*.

th....... as in *thin*.

th....... as in *though*, *them*, *mother*.

v....... as *w* in German *zwei*, and *b* in Spanish *Cordoba*.

sh....... as in *shine*.

zh....... as *s* in pleasure, and *j* in French *jour*.

All other letters are used with their ordinary English values.

NOTE.

The values of most of the signs used in the above Key are plainly shown by the examples given. But those of ö, ü, ch, *k*h, ñ, and *v*, which have no equivalents in English, can not be sufficiently indicated without a brief explanation, which is here given.

ö. The sound represented by this symbol is approximately that of -u- in *hurt* or -e- in *her*, but is materially different from either. It is properly pronounced with the tongue in the position it has when ā is uttered and with the lips in the position assumed in uttering ō.

ü. This vowel is produced with the lips rounded as in uttering oo and with the tongue in the position required in uttering ee, into which sound it is most naturally corrupted.

ch and *k*h. These are both rough breathings or spirants made with considerable force, ch being made between the flat of the tongue and the hard palate, and *k*h between the tongue and the soft palate. ch approaches in sound to English sh, but is less sibilant and is made further back in the mouth; *k*h is a guttural and has a hawking sound.

l or y. These are both used to represent the sound of French l mouillé, in (-i)ll- and (-i)l, which resembles English -y- in *lawyer*. Final *l*, that is, (-i)l, may be approximated by starting to pronounce lawyer and stopping abruptly with the -y-.

ñ or n-y. The consonants represented by ñ (Spanish ñ, French and Italian gn, etc.) are practically equivalent to English -ni- or -ny- in bunion, bunyon, onion, etc., and, except when final, are represented by n-y. Final ñ, as French -gn(e), may be produced by omitting the sound of -on in the pronunciation of *onion*.

v. This may be pronounced by attempting to utter English v with the use of the lips alone.

See Preface (vol. i., p. xli.) and the article Pronunciation of Foreign Names.

THE

UNIVERSAL CYCLOPÆDIA.

Eiffel, ef'fel, GUSTAVE: civil engineer; b. at Dijon, France, Dec. 15, 1832; after graduating at the École centrale in 1855, attached to the administration of the Western Railway of France; from 1858 devoted himself to metallic constructions. In that year he superintended the construction of the bridge of Bordeaux, the foundations of which were cylinders sunk by means of compressed air—a method which had but recently been applied to that purpose. In 1867 he made the calculations for the metallic arches of the Machinery Gallery of the Exposition building of that year, and tested his results by experiments upon the arches themselves. In 1868 he constructed two of the high viaducts between Commentry and Gannat. He has applied methods peculiar to himself in the erection of girder bridges, of which he has built a large number. He constructed the large iron arched bridge of the Douro in Portugal, and that of the Garabit in Central France, both of which were erected without false works. He also constructed the principal façade of the Exposition of 1878 (Grande Galerie and Dômes). He invented a portable bridge, for which he received the prize Elphège-Baude. The revolving dome of the observatory of Nice, which was also designed by him, can be turned by a single person, although it weighs 100 tons. One of his greatest works is the EIFFEL TOWER (*q. v.*) of the Exposition of 1889, on the completion of which he was made an officer of the Legion of Honor. He has written papers upon the arches of the Machinery Gallery of 1867, and upon the Douro and Garabit viaducts, and a discussion of the Eiffel tower.

WILLIAM RICH HUTTON.

Eiffel Tower: a tower erected on the grounds of the French International Exposition in 1889. It is 300 meters, or 984 feet, in height, of light structure and graceful form. Visitors are carried to the upper platform by elevators. Meteorological observations are carried on at the top, affording very important results.

Ei'kon Basil'ike, or **I'con Basil'ice** (Gr. εἰκὼν βασιλική, likeness of the king): a book descriptive of the sufferings of King Charles I. of England, and professing to be an autobiography. It was published in 1649 immediately after the execution of the king, and became very popular. Some historians believe that it was composed by Bishop Gauden (1605–62), who about 1660 laid claim to the sole authorship. In his *History of Oliver Cromwell and the English Commonwealth*, Guizot characterizes it as "a constant mingling of blind royal pride and sincere Christian humility; heart-impulses struggling against habits of obstinate and haughty self-consciousness; invincible, though somewhat inert, devotion to his faith, his honor, and his rank; and all these sentiments are expressed in a monotonous language which, though often emphatic, is always grave, tranquil, and even unctuous, full of serenity and sadness. It is not surprising that such a work should have profoundly affected all royalist hearts."

Eilenburg, ī'len-boor*k*h: town of Prussian Saxony; on an island in the river Mulde; 27 miles E. N. E. of Merseburg (see map of German Empire, ref. 4–F). It has an old castle and two bridges; also manufactures of calico, woolen yarn, brandy, chemicals, starch, and tobacco. Pop. (1890) 12,477.

Eilethyia: ancient city of Egypt, whose modern name is El Kâb; on the right bank of the Nile, near Edfu; contains curious and interesting ruins, the most important of which are the rock-tombs excavated in a hill. Some of these date from the thirteenth dynasty, and throw much light upon the every-day life of the people. The tomb of Aahmes, the captain of the Egyptian flotilla, bears an inscription which records his services to the monarchs of the eighteenth dynasty in the Shepherd wars, and mentions the fort of Suben (Lucina or Eilethyia, the goddess of the city), the ruins of which are still standing. Small temples dedicated to Ra, a Ptolemaic temple dedicated to Lucina, and an ancient temple dedicated to the local deities, are also to be found there, together with the tomb of Pahir, decorated with rich and elaborate paintings.

Eimeo: one of the Society islands. See the Appendix.

Einbeck: town of Hanover, Germany. See the Appendix.

Einhard: See EGINHARD.

Einsiedeln, īn'sēē-deln: town of Switzerland; in the canton of Schwytz; about 24 miles S. S. E. of Zurich (see map of Switzerland, ref. 4–G). Here is a famous Benedictine abbey, containing a black image of the Virgin Mary, which is visited annually by about 20,000 pilgrims. An abbey was built here in the ninth century, but the present edifice was erected about the year 1720. It contains a large library, and in connection with it are a priests' seminary, a gymnasium, a lyceum, etc. The town contains a great number of inns. Large numbers of prayer-books, sacred images, and rosaries are made here. Zwingli the Reformer was curate of Einsiedeln in 1516. Pop. (1888) 8,512.

Eisenach, ī'zen-aă*k*h: town of Saxe-Weimar, Germany; finely situated amid wooded hills on the river Hörsel and on the railway from Leipzig to Cassel; about 48 miles W. of Weimar (see map of German Empire, ref. 5–F). It is well built, with wide and clean streets, is inclosed by walls, and has a handsome ducal palace, now used as a court-house, several churches, and a school of design. Here are manufactures of cotton and woolen fabrics, art pottery, leather, carpets, soap, white lead, etc. In close proximity to this town is the Castle of Wartburg, formerly a residence of the landgraves of Thuringia, and memorable as the place of refuge in which Luther remained secreted ten months (1521–22), having been carried thither for safety by his friend, the Elector of Saxony. The castle has been restored since 1851. Pop. (1890) 21,399.

Eisenberg, ī'zen-bārch, town of Saxe-Altenburg, Germany, near the Saale; 26 miles E. of Weimar (see map of German Empire, ref. 5–F). It has a castle, an observatory, and a town-house; also manufactures of porcelain and woolen stuffs. Pop. (1890) 7,349.

Eisenburg, ī'zen-boor*k*h (Hun. *Vas*): county of South-western Hungary; bounded N. by Oedenburg, E. by Veszprem, S. by Zala, and W. by Styria. Area, 1,945 sq. miles. The soil is very fertile. The chief products are grain, tobacco, flax, wine, and fruit. Pop. (1890) 389,854.

Eisenerz: a town of Styria, Austria. See the Appendix.

Eisenstadt: market-town of Hungary. See the Appendix.

Eisleben, īs′lā-ben: town of Prussian Saxony; about 20 miles W. of Halle, with which it is connected by a railway (see map of German Empire, ref. 4–F). It is divided into the old and the new town, the former of which is inclosed by walls. It has an old castle and a gymnasium, also manufactures of potash and tobacco. Copper and silver are mined in the vicinity. Martin Luther was born here in 1483, and died here in 1546. The house in which he was born was partially consumed by fire in 1689, but has been restored. In the Church of St. Andrew are preserved his cap, cloak, and other relics. A bronze statue of the great Reformer was erected in 1883. Pop. (1890) 23,903.

Eisteddfod, ā-steth′vōd: a congress of Welsh bards and musicians for promoting the cultivation of the national poetry and music, and secondarily of maintaining the traditions and customs of the country. Its origin is very ancient, probably dating from a time long previous to the Christian era, but the first meeting of which there is any record was held on the Conway in North Wales in the sixth century. The term Eisteddfod, however, was probably not applied to these sessions till early in the twelfth century, when such an assembly was called at Caerwys, in Flintshire, and attended by all the bards of Wales and some from England and Scotland. Here and at other royal seats the congresses were held for a long time every three years, and being under the patronage of the princes were generally occasions of magnificent display. Poetical and musical contests were the chief features of these gatherings. Degrees and prizes were conferred upon the successful competitors, who were thereby raised to a position of high honor and admitted to the halls of the Welsh princes and nobles. Edward I. sanctioned these bardic congresses by his statute of Rhuddlan, and they occurred in the reigns of Edward III., Henry VI., Henry VIII., and Elizabeth, often under the royal permission or patronage. There was an important one held at Bewper Castle, Glamorgan, in 1681, but from that time till 1819 little is heard of them. At the latter date the reawakening of the Welsh national spirit gave them a new impulse, and they have since then been held annually and attended by large numbers. A Gorsedd is held at the conclusion of each Eisteddfod, and the degrees conferred and the place of the next festival announced. F. M. Colby.

Eitelberger von Edelberg, ī′tel-bărch-er-fōn-ā′del-bărch, Rudolf: art-historian; b. at Olmütz, Austria, Apr. 14, 1817; became in 1852 Professor of Art History at the University of Vienna, and contributed much to the improvement of Austrian industry and art. He wrote, among other works, *Die Reform des Kunstunterrichts* (1848); *Mittelalterliche Kunstdenkmale des Oesterreichischen Kaiserstaats* (2 vols., 1858–60); and *Quellenschriften zur Geschichte der Kunst des Mittelalters und der Renaissance* (1871). D. in Vienna, Apr. 18, 1885.

Ejectment [from Lat. *eji′cere*, *ejec′tum*, cast out; *e*, out, + *ja′cere*, cast]: in law, a *mixed* action, as it is resorted to in order to recover the possession of land, and damages for the wrongful withholding of it, though the damages are nominal. Originally, it was a "possessory" action—that is, adapted to the recovery of the possession of land. By a series of fictions it finally came to be a convenient means of testing the title. The substance of the fiction was a supposition that a lease for a certain number of years had been made to a tenant, John Doe, who had entered into possession, and had then been ejected by a person supposed to represent the party to be ultimately made defendant. This person was termed "a casual ejector," and was usually represented as Richard Roe. An action was then brought substantially under the following title: "Doe, as tenant of Edwards (claiming the land), against Roe." A written notice was thereupon sent in the name of Roe by Edwards's attorney to the opposing claimant (Archer), who is the party in possession. By this notice Archer was advised to defend the action, otherwise Roe would allow judgment to be taken against him and the possession would be lost. Archer, on making application to be made defendant, was allowed to defend upon condition that he would admit the validity of the fictitious portion of these proceedings; so that the matter was narrowed down to a trial of the merits of the case. The action was now deemed really to be between Edwards and Archer, though Doe still remained plaintiff on the records of the court. It is a well-settled rule in this action that the plaintiff can only recover upon a *legal* title, as distinguished from a title in a court of equity. He can succeed only upon the validity of his own title, and not upon the weakness of that of his adversary. He must also have, in legal phrase, a "right of entry." Where that does not exist another form of action must be adopted. There was one serious practical inconvenience following this method of procedure. There was no limit in law to the number of successive actions of ejectment that could be brought by a plaintiff, although he had been worsted. He had only to substitute another fictitious tenant in the place of Doe, and all the proceedings might be gone through with again. The only check upon repeated actions of this kind was a resort to a court of equity for an injunction to prevent harassing, and perhaps exhausting, litigation. The fictitious portion of the proceeding was abolished in England by the Common-Law Procedure Act of 1852, and the action placed upon satisfactory grounds. The same result had been accomplished as early as 1830 in New York.

Should the plaintiff succeed in his action, he has also an independent cause of action for the loss of profits sustained by reason of the defendant's wrongful possession. This is known as an action of trespass for *mesne* (intermediate) profits. In some of the U. S.—e. g. New York—this cause of action may be united with the action of ejectment. The recovery would, by the statute of limitations, commonly be limited to the mesne profits for the last six years.
T. W. Dwight.

Ekaterinburg, ā-kăă-tā-reen-boorg′: fortified town (founded in 1722); government of Perm, Russia; 160 miles S. E. of Perm (see map of Russia, ref. 6–I). It has straight broad streets, many churches, manufactures of metals, and government mints, and is the principal city of the mining district in the Ural Mountains. Pop. (1897) 43,052.

Ekaterinodar′, or **Jekaterinodar**: the chief town of the Kuban territory, Southern Russia; on railway, and on the right bank of the Kuban river; in lat. 45° 3′ N., lon. 38° 30′ E.; 555 miles N. W. of Tiflis (see map of Russia, ref. 11–E). It is on a swampy site, subject to overflow, and the houses are wooden structures. It was founded in 1792, in the reign of Catherine II., and is now the seat of the hetman of the Chernomonan Cossacks. It has an active though local trade, and one of the government horticultural institutions is established in the vicinity. Pop. (1871) 17,622; (1897) 65,697.
M. W. H.

Ekaterinoslaf′: a government of Southwestern Russia; bounded N. by Kharkof and Poltawa, E. by the country of the Cossacks of the Don, S. by Tauria and the Sea of Azof, and W. by Kherson. Area, 26,148 sq. miles. It is traversed by the Dnieper, the Samara, and the Waltschija, and consists almost entirely of large steppes. The soil is fertile. Pop. (1897) 2,112,651.

Ekaterinoslaf: city of Russia; capital of the government of same name; situated on the Dnieper, 115 miles S. W. of Kharkof (see map of Russia, ref. 10–D). It was founded in 1784 by Prince Potemkin, and named after the Empress Catherine II., in whose honor a monument has been built. It has a large cloth factory, and many other manufactures. Pop. (1888) 46,876; (1897) 121,216.

Ek′ron: one of the royal cities of the ancient Philistines, and the seat of an oracle of Beelzebub; in Judea; about 25 miles W. by N. from Jerusalem. Its site is identified with the modern *Akir*, or *Akree*. Although no longer powerful, it was a large village in the time of the crusades, but now consists of about fifty mud huts.

Elæagna′ceæ [deriv. of Lat. *elœag′nus* = Gr. ἐλαίαγνος, a Bœotian marsh-plant]: a family of exogenous plants (trees or shrubs), natives of Europe, North America, and other parts of the northern hemisphere, being rare south of the equator. They have entire leprous or scurvy leaves, a superior ovary, and apetalous flowers. Several species indigenous in Persia and Nepaul bear edible berries. This order also comprises the *Shepherdia argentea*, or buffalo berry, which grows near the upper Missouri river, and bears a pleasant acid fruit; this and the *Shepherdia canadensis* and the *Elæagnus argentea* (silver berry of the Northwest) are the only known North American species. The oleaster (*Elæagnus angustifolia*) is a native of the Levant and Southern Europe. This tree is often planted in shrubberies for the sake of its fragrant yellow flowers and its silvery white foliage. It attains a height of nearly 20 feet.

Elæagnus: a genus of the family Elæagnaceæ (*q. v.*).

Elæ′is [from Gr. ἔλαιον, olive oil, ἐλαία, olive-tree]: a genus of trees of the family *Palmaceæ*. The *Elæis guineensis*, or oil-palm, a native of Western Africa, produces the palm oil which is extensively used in the manufacture of candles and soap. This tree abounds in the tropical parts of Africa, and bears a very large quantity of fruit, from the outer fleshy rind or coating of which the oil is obtained by boiling in water. This oil is made into soap more readily than any other known oil. A still further supply of oil can be obtained by treatment of the boiled fruit. This is called palm-nut oil. This species and others of the genus have been naturalized to some extent in tropical America, where they are cultivated for their oil. They also yield a pleasant alcoholic drink.

Elæococ'ca [from Gr. ἐλαία, olive-tree + κόκκος, berry]: a genus of plants of the family *Euphorbiaceæ*. Useful oil is obtained from the seeds of several species. A tree called *Elæococca verrucosa* is cultivated in Mauritius and Japan for its oil, which is used for burning. One or more species in China yield drying oils, used in that country for preparing varnishes and paints. These oils have acrid properties.

Elæoden'dron [from Gr. ἔλαιον, olive oil + δένδρον, tree]: a genus of trees belonging to the family *Celastraceæ*. *Elæodendron croceum*, commonly called saffron-wood, grows near the Cape of Good Hope, where it is prized for building and cabinet-work. *Elæodendron glaucum*, found in Southern India, is called the Ceylon tea-tree. Some of the species yield a fixed oil like oil of olives.

Elagab'alus, or **Heliogab'alus**, Marcus Aurelius Antoninus: a Roman emperor; b. in Syria in 204 A. D. His original name was Varius Avitus Bassianus, but on being appointed a priest of the sun-god, whom the Syrians called Elagabal, he assumed that name. Caracalla was assassinated Apr. 8, 217 A. D., and Macrinus was proclaimed emperor Apr. 11, 217. Elagabalus was proclaimed emperor by the army in Syria May 16, 218. A battle was fought between Macrinus and Elagabalus June 8, 218, and Macrinus was put to death some days afterward. Then followed a reign marked by such excesses of self-indulgence and cruelty as to make him the type of all the vices that characterized the corrupt society of the later empire. Altars were erected in Rome to the sun-god, whom he continued to worship with licentious rites. He was assassinated by his soldiers Mar. 11, 222 A. D., and succeeded by Alexander Severus.

Ela'in: same as Olein (*q. v.*).

E'lam: the name given in the Bible and in the cuneiform inscriptions to that part of the ancient Persian empire called Susiana and Cissia by the Greeks; the Elymais of the Greeks appears to have been only that part of Susiana next the Persian Gulf. Shushan or Susa was its chief city. The ancient inhabitants, like the modern, were chiefly nomadic. The northern part is mountainous, the southern flat, the gulf coast marshy and unproductive.

E'land [Dutch *eland*, elk, borrowed from Germ. *Elend*, *Elen* (*Elenthier*), itself a loan-word from Lith. *élnis*, elk; cf. Gr. ἔλαφος, stag]: an African antelope (*Oreas canna*), the largest of the family. It is about the size of a horse, meas-

Eland.

uring 5 feet high at the shoulder, with two horns, nearly straight, about a foot and a half long and turned backward. In form it somewhat resembles the ox, being much less slender in the body and limbs than other antelopes, and having an enormous dewlap. The eland is usually in good condition, and being from its size and fatness a poor runner, is captured with comparative ease by mounted hunters. It is gregarious in habit, and was formerly extremely abundant in Southern Africa, but owing to the demand for its flesh and hide, the one being remarkably good for the table, while the other makes excellent leather, this fine animal has sadly diminished in numbers, and in many localities is quite exterminated. Although the eland can be readily domesticated, it is an unprofitable animal to raise for market.

F. A. Lucas.

Ela'net: any bird of the genus *Elanus*. It is of the kite kind, but differs from them in having the claws, except that of the middle toe, rounded, and the tarsi partly covered with feathers. The black-shouldered hawk (*Elanus glaucus*) is found in the U. S., and *Elanus melanopterus* is a native of Africa and India, and is found in Europe and even in Australia. The elanet is a bold and active little bird, feeding mostly on insects, but often capturing snakes, and more rarely mice and birds.

E'laps [from Gr. ἔλλοψ, ἔλοψ; originally the name of a harmless serpent]: a genus of venomous snakes found in tropical and sub-tropical America. The snakes of this genus are mostly under 3 feet in length, with a small head and tapering tail, and are beautifully marked with rings of red, black, and yellow. The bite of the larger species is dangerous, and even the smaller species should be handled with care, since, in spite of assertions to the contrary, it is certain that some of them can inflict a painful, lingering wound. This is true of the bead snake or coral snake (*Elaps fulvius*) of the Southern U. S., a snake not uncommon in Florida, and said to be often dug up in sweet-potato fields. Two other species also occur in the U. S., *Elaps distans* and *E. euryxanthus*.

F. A. Lucas.

El Araish [i. e. the garden of enjoyment], called **Carache**, or **Larache**: a fortified town of Morocco; province of Aygar; at the mouth of the Luccos, which forms an excellent but shallow harbor; lat. 36° 13′ N., lon. 6° 9′ W.; 15 leagues S. W. of Tangier (see map of Africa, ref. 1–B). The surroundings are covered with olive groves and rich pomegranate and orange orchards, but are not healthful. The town has a fine old mosque and market-place. It exports corn, cork, wool, and beans. Pop. 5,000.

El Arish (anc. *Rhinocolura*): a walled town of Egypt; on the confines of Palestine, near the Wady el Arish. It is situated on an eminence half a mile from the Mediterranean, in lat 31° 6′ N., lon. 33° 56′ E.; 195 miles N. E. of Cairo and about 30 miles S. W. of Gaza. It has a few remains of the Roman period. The ancient *Rhinocolura* is said to have been founded by King Actisanes of Æthiopia as a penal colony, and the convicts sent thither had their noses cut off. Before the rise of Alexandria this town was a great emporium of the Red Sea trade. The Wady el Arish is supposed to be the "river of Egypt" mentioned in the Bible. It drains the central part of the peninsula of Sinai, and empties into the Mediterranean near El Arish; hence the name.

Elasmobran'chiates [from Gr. ἐλασμός, ἔλασμα, metal beaten into thin plates (deriv. of ἐλαύνειν, drive, beat) + βράγχια, gills]: the class of vertebrates containing the sharks, rays, and chimæras; intermediate between the true fishes and the Marsipobranchiates. They may be briefly defined as lyriferous vertebrates, destitute of membrane or dermal bones, and with the branchial chambers separate from each other.

Geographical Distribution.—The class, which appears to have been a predominant one, and of which the members formerly outnumbered those of the true fishes, is on the wane, and contains not many more than 300 species. These are quite generally distributed, and have the following systematic relations: Of the *Squali* nearly 150 species are known; of the *Raiæ* about 165 have been described; and of the *Holocephali* but 4 or 5 species are inhabitants of the waters of the present epoch. The class, as a whole, is developed in the greatest perfection in the tropical and warm oceans, but representatives extend toward both poles, and some are found in the high polar regions. Many of the *Squali* are animals of great activity, and endowed with the power and will for extensive wandering, and are met with in mid-ocean; the species, therefore, sometimes have a great range; for example, the typical sharks of the family *Galeo-*

rhinidæ, in some respects the highest and most wide-ranging of the class. To this family belong several of the most common species of the eastern American coasts. Equally wide-ranging, and perhaps still more admirably adapted for a wandering life, and even more formidable in their armature, are the *Lamnidæ*, which include the mackerel sharks and the formidable man-eater (*Carcharodon carcharias*, etc.). The families of more limited distribution are the *Scylliidæ*, which are chiefly represented along the shores of the Old World and Australia; the *Pristiophoridæ*, which are peculiar to the oceans of China, Japan, and the neighboring seas; and the *Heterodontidæ*, which are confined to the Pacific. The representatives of the order *Raiæ* are distributed in an analogous manner. The most widely diffused of the types is the family of *Raiidæ*; all the others are more limited in their range, at least toward the northward and southward, and are, on the whole, less represented by species and by individuals in the regions where they occur at all. The *Chimæridæ* of the present epoch are rather cold-water types; and of the generic or super-generic types one (*Chimæra*) is represented by species of the northern seas, and another (*Callorhynchus*) by species in southern waters. The oceans are the stations for which all the members of the class are most fitted; but although, on the whole, they are essentially marine types, nevertheless some are found at times, and a few permanently, in fresh waters. THEODORE GILL.

Elastic Curve: in mechanics, defined by James Bernoulli as the figure which would be assumed by a thin horizontal elastic plate if one end were fixed and the other loaded with a weight. The curve assumed by a plate or beam when resting upon two supports and loaded with weights is also an elastic curve, provided that the weight be not so great as to impair the elastic properties of the material. These curves belong to the class known as cubic and quartic parabolas, the cubic ones being for single loads and the quartics for uniform loads. See FLEXURE.

MANSFIELD MERRIMAN.

Elasticity [from Gr. ἐλατικός (as if *ἐλαστικός), driving, ἐλατήρ, driver, deriv. of ἐλαύνειν, drive]: the property possessed by certain bodies of recovering their original form and size after the external force is withdrawn by which they have been compressed. Matter is believed to be composed of molecules or small particles, acted upon by attractive and repulsive forces, and from the combined action of these forces result the various forms and properties of matter. According to this view, molecules are not in contact, but at an infinitesimal distance from each other, which, however, may be increased or diminished. When the body is at rest the opposite forces which any of its molecules exercise on each other are in equilibrium. If the distance between the molecules be increased within the limits of the action of the forces, both forces are diminished; and if the distance is lessened, both are increased, but not in the same proportion. Solid bodies are imperfectly elastic, and do not entirely recover their form when the disturbing force is removed; but there seems to be no limit to the elasticity of gases. The phenomena of elastic bodies are—1. That a perfectly elastic body exerts the same force in restoring itself as that with which it was compressed; 2. The force of elastic bodies is exerted equally in all directions, but the effect takes place chiefly on the side where the resistance is least; 3. When a solid elastic body is made to vibrate by a sudden stroke, the vibrations are made in equal times to whatever part of the body the stroke may be communicated. No theory of elasticity founded on any assumed hypothesis as to the molecular constitution of matter has as yet been found satisfactory when applied to solids. In this case, therefore, the theory of elasticity is best investigated without resorting to any such hypotheses.

Elastic Limit: the limit to which a body can be strained and yet recover its original shape when the strain is removed. A strain carried beyond this causes permanent deformation. See FATIGUE OF MATERIALS.

Elastic Tissue: a form of fibrous tissue, sometimes called **Yellow Fibrous Tissue**, which may be drawn out to twice its original length, to which it returns when released. It is found in the membranes which connect the cartilaginous rings of the trachea and various other structures of the animal body requiring elasticity. In the human body perhaps the most remarkable example of the elastic tissue is seen in the *ligamenta subflava*, or intervertebral ligaments. Almost all other ligaments are unyielding and inelastic, but these are extremely elastic. Their action is to help restore the spinal column to its vertical position when it has been deflected by muscular action. In some of the lower animals the *ligamentum nuchæ*, the great ligament of the nape of the neck, is highly elastic, and serves to maintain the proper equilibrium between the muscles that erect and those that depress the head, as when the animal is grazing.

El′ater [Gr. ἐλατήρ, driver, deriv. of ἐλαύνειν, drive]: a Linnæan genus of coleopterous insects, now the type of a very large and distinct family of the serricorn Coleoptera, called *Elateridæ*. They have a narrow, elongated body, and are distinguished by the presence of a strong spine projecting from the posterior margin of the prosternum, and a groove or socket fitted for the reception of the spine. If they fall on their back, they recover their feet by a violent muscular effort, which throws them into the air with a jerk and a clicking sound. Hence they are called click-beetles, snap-bugs, etc. This movement is the rebound caused by the sudden disengagement of the spine from its socket. The wireworms of the U. S. are larvæ of the *Elateridæ*, and are very destructive to growing crops. The elaters feed on flowers, leaves, and other soft parts of plants. The firefly of tropical America is the *Elater* or *Pyrophorus noctilucus*, and it has been discovered that the larvæ of at least one North American species of *Melanactes* are luminous.

Elate′rium [Gr. ἐλατήριον (sc. φάρμακον, medicine), cathartic, driving, deriv. of ἐλαύνειν, drive]: a drug obtained from the *Ecbalium elaterium*, or wild cucumber, called also squirting cucumber. It is an annual belonging to the family *Cucurbitaceæ*, with a trailing stem, heart-shaped leaves, lobed and toothed, yellow flowers, axillary; fruit grayish green, about $1\frac{1}{2}$ inches long, covered with soft prickles. The fruit in parting from its stalk expels the seeds, along with a mucus, through the opening in which the stalk was inserted. Elaterium is contained in the thick green mucus surrounding the seeds. It is a powerful hydrogogue cathartic, dangerous when used in excess, and is very irritating to the eyes and skin. The active principle called elaterin is obtained from it. Elaterium is sometimes used in dropsy.

E′lath (Heb. *Eloth*, trees; Lat. *Æla′na* or *Ela′na*): a town several times mentioned in the Bible; situated at the foot of the valley El Ghor in Idumæa, and at the head of the Elanitic arm of the Red Sea (now known as the Gulf of Akabah); near lat. 29° 30′ N., lon. 30° E.; 10 miles E. of Petra. It was conquered by King David, and under Solomon became an important commercial emporium. It continued to be a seaport of importance under the Romans. It was twice taken by the crusaders (1116 and 1182 A. D.), but after their time fell into decay. It stood on or near the spot now occupied by the fortress of Akabah, which is held by a small garrison of Egyptian troops.

El′ba (Fr. *Elbe*; anc. *Il′va* and *Ætha′lia*; Gr. Αἰθαλία): an island of Italy; in the Mediterranean Sea, between Corsica and Tuscany; from the latter it is separated by a channel 6 miles wide. It is about 18 miles long, and varies in width from $2\frac{1}{4}$ to 10 miles; area, 87 sq. miles. The coasts are bold and deeply indented by several gulfs which form good harbors. The surface is mountainous, and the highest point has an altitude of about 3,500 feet. The island has no manufactures; among its agricultural products are wine, wheat, olives, and various fruits. Excellent iron ore is found here, which on account of the lack of fuel is not smelted, but shipped directly to the opposite coast of the mainland. The sardine and tunny fisheries are of some importance. The climate is mild and equable, and the whole island salubrious with the exception of a few spots on the coasts. Pop. 23,000. Capital, Porto-Ferraio. By the Treaty of Paris this island was designated as the residence of Napoleon I., who removed to it May 4, 1814, and escaped Feb. 26, 1815.

Elbe (anc. *Al′bis*; Bohemian, *La′be*; Dutch, *El′ve*): an important river of Germany; rises in the northeastern part of Bohemia, among the mountains called Riesengebirge. One of its sources is about 4,500 feet above the level of the sea. It flows generally in a northwestern direction, drains the northern part of Bohemia, intersects Saxony and Prussia, and enters the German Ocean near Cuxhaven; at this point the tide rises about 10 feet. It drains an area of over 55,000 sq. miles. Its total length is about 725 miles. This river is several miles wide at every point between its mouth and Altona, a distance of nearly 70 miles. Its principal affluents are the Havel, the Moldau, the Saale, and the Eger. The chief towns on its banks are Dresden, Magdeburg, Hamburg, and Altona. Between Dresden and Aussig it flows between high rocky banks like natural battlements, and presents very picturesque scenery. Vessels drawing 14 feet of water can ascend at all times to Hamburg. Small steamboats navigate the Elbe between Hamburg and Magdeburg, and between Meissen and the mouth of the Moldau. Navigation was formerly restricted by tolls and taxes, but was made free in 1870.

El Beni: province of Bolivia. See BENI.

Elberfeld, el'ber-felt: an important manufacturing town of Rhenish Prussia; on the Wupper; 16 miles E. of Düsseldorf, with which it is connected by a railway (see map of German Empire, ref. 4–C). It is irregular in plan, and is several miles long. The newer streets are well paved. Barmen, a rich and prosperous town, is contiguous to the eastern part of Elberfeld, which has a normal school, an asylum for the deaf and dumb, a museum, a public library, and extensive manufactures of silk stuffs, velvets, cotton fabrics, merinos, ribbons, and tapes. Elberfeld has about 70 dyeing establishments, 10 bleaching-grounds, and several print-works. It is famous for the dyeing of Turkey red, and this dye is said to be imparted here at a cheaper rate and with more firmness of color than at any other town in Europe. Pop. (1900) 156,937.

Elberton: town; capital of Elbert co., Ga. (for location of county, see map of Georgia, ref. 2–I); situated on the Ga., Car. and N. railway; 100 miles E. by N. of Atlanta. It is the terminus of the Elberton Air Line railway, and has 3 churches, a college, a public library, very extensive granite quarries, a cotton-factory, 3 fertilizer-factories, cottonseed-oil mill, etc. Cotton is the chief agricultural product. Pop. (1880) 927; (1890) 1,572; (1900) 3,834.
EDITOR OF "STAR."

Elbeuf, el'böf', or **Elbœuf**: town of France; department of Seine-Inférieure; beautifully situated on the left bank of the Seine, 12 miles above Rouen and 75 miles N. W. of Paris (see map of France, ref. 3–E). Several of the newer and finer streets converge to a spacious open area called Champ de Foire. It has eight artesian wells and six public fountains. Among the finest edifices are the churches of St. Étienne and St. Jean Baptiste. Steamers ply daily between this place and Paris and Havre. It has important manufactures of fine flannels, billiard-table covers, habit cloths, checkered stuffs, woolen fabrics, chemicals, machinery, etc. Pop. (1896) 20,542.

El'bing (Lat. *Elbinga*): fortified town and river-port of Prussia; on the navigable river Elbing; 5 miles from its entrance into the Frische Haff, and about 40 miles E. S. E. of Dantzic (see map of German Empire, ref. 2–J). It has a gymnasium founded in 1536, a normal school, an asylum for the deaf and dumb, and a large public library; also manufactures of cotton and linen fabrics, sailcloth, soap, tobacco, leather, etc., iron-foundries, dye-works, print-works, and sugar-refineries. The town originated in the beginning of the thirteenth century, when German colonists from Lübeck and Bremen settled around a fortress which the Teutonic knights had built, in the midst of the Slavic population. It rendered homage to the Kings of Poland in the fifteenth century, but was gained by Albert of Brandenburg in 1525, and finally passed to Prussia in 1772. Pop. (1890) 41,578.

El Bostan: See ALBISTAN.

Elbruz: the loftiest range and summit in the Caucasus, between the Black and Caspian Seas. Mt. Elbruz is situated in lat. 43° 20′ N., lon. 60° E.; its altitude is 18,570 English feet.

Elburz: a range of high mountains in the northern part of Persia; forming the connecting chain between the Anti-Taurus and the Kuen-Lun. The Elburz extends nearly parallel with the south shore of the Caspian Sea, and forms the southern boundary of the basin of that sea. The highest point of this range is the volcanic peak of Demavend, which rises about 18,600 feet above the level of the sea.

Elces'aites, or **Elkesaites** [from *Elxai* or *Elkasai*, the name of their founder or of a book containing their doctrines]: a sect of Essenian Ebionites, or of Jewish Christians who in the second century mingled Judaism and Christianity in their doctrines, adding to them certain pagan or Gnostic views and magical practices. This sect appears to have originated in the early part of the second century, and probably lasted till the fourth century. They claimed to be in possession of a book which had fallen down from heaven to them, or at least been specially revealed to them by the Son of God. The book, which was a coarse mixture of Christian, Judaistic, and pagan elements, was widely circulated and highly esteemed. The fragments are given in Hilgenfeld, *N. T. extra canonem receptum*.

El'che (anc. *Il'ici* or *Il'lice*): town of Spain; province of Alicante; about 6 miles from the sea and 15 miles S. W. of the city of Alicante (see map of Spain, ref. 18–I). It is situated on both sides of a steep ravine, which is crossed by a handsome bridge. It has an Oriental aspect, being built in the Moorish style and surrounded by large groves of date-palms. Among the remarkable edifices are an old castle, and a church which has a majestic dome and a famous organ. There are manufactures of cotton and linen stuffs, brandy, wine, cigars, and soap. Large quantities of dates are exported. Pop. (1887) 23,854.

Elchingen, el'ching-*en*: village of Bavaria; on the left bank of the Danube; 8 miles N. E. of Ulm (see map of German Empire, ref. 7–E). Here the French marshal Ney defeated the Austrians on Oct. 14, 1805. Pop. 500.

El'cho, FRANCIS WEMYSS CHARTERIS DOUGLAS, Lord: statesman; eldest son of Francis Wemyss Charteris Douglas, Earl of Wemyss; b. in Edinburgh, Scotland, Aug. 4, 1818; educated at Oxford. He became a Conservative member of Parliament in 1841, and was a Lord of the Treasury from 1852–55. He took a prominent part in the formation of the National Rifle Association in 1860. In 1866 he opposed the Reform bill of Russell and Gladstone, and was connected with the party called "Adullamites." He represented Haddingtonshire in Parliament from 1847 until he succeeded his father as ninth earl in 1883; author of *Letters on Military Organization* (1871).

Eldad Ben Malchi, also called **Ha-Dani**, or **The Dan'ite**: a Jewish traveler of the ninth century of the Christian era; a native either of Southern Arabia or of Media, who about 860 undertook extensive journeys in order to visit his Jewish brethren in Asia and Africa, and among his many other adventures at one time fell into the hands of cannibals. Ransomed by a countryman of his, he was able to continue his voyages, and visited both China and Spain. The work which bears his name is written in Hebrew and consists of six books, but it seems to be only an abbreviation, and not the original form of the narrative. It was first printed in Constantinople in 1518, then at Venice in 1540 and 1605, and often afterward. There exists a Latin translation of it by Genebrard, *Eldad Danius de Judæis clausis eorumque in Œthiopia imperio* (Paris, 1563); there is also a German translation. The most complete text and translation are found in Dr. Jellinck, *Bet-Ha-Midrasch* (Leipzig, 1853–55). One of the most curious passages in the whole work is the account of the Levites, who, according to the author, were miraculously guided into the land of Havila, and were there protected from their enemies by the mystic river Sabbation, which is calm but covered with dense fog on the Sabbath, and impassable on other days.
Revised by C. H. TOY.

El Dakkel (anc. *Oasis Minor*): the third of the five Egyptian or Libyan oases; situated in lat. 29° 10′ N. It is well watered and has warm springs. It produces dates, olives, etc., and in ancient times yielded much wheat.

Elder: a shrubby plant belonging to the genus *Sambucus* and family *Caprifoliaceæ*. The common elder (*Sambucus canadensis*) of North America grows from 5 to 10 feet high. Another American species is the red-berried elder (*Sambucus racemosa*), which is found in rocky woods and among mountains. It is found in some parts of Europe, and is prized as an ornamental shrub. The common elder (*Sambucus nigra*) is indigenous to Europe and parts of Asia and Northern Africa. It sometimes attains the size of a small tree, having pinnate leaves, terminal cymes of creamy white flowers, and small black berries, three-seeded. The dwarf elder or danewort (*Sambucus ebulus*) is seen occasionally in Great Britain. It was formerly believed to have sprung from the blood of Danes killed in the Anglo-Saxon wars. The flowers of the elder are used in medicine, and elder-flower water, employed in perfumery, is distilled from them. Wine is also made from the berries.

Elder [O. Eng. *eldra* : O. H. G. *altiro*, Mod. Germ. *älter* : O. N. *eldre* : Goth. *alþiza*, compar. of Teuton. *alđoz* > Eng. *old*]: a term used to translate Heb. *zaken*, Gr. πρεσβύτερος, etc., words originally indicative of age, but acquiring in time a secondary official sense. Each Hebrew town had its senate of elders, who administered justice. (Deut. xix. 12.) Commonly, each synagogue had also its board of elders, although in smaller towns there was often but a single rabbi. The early Christian Church is believed by many to have borrowed its eldership from the Jewish synagogue. In the New Testament elder and bishop are thought by many Christians to be identical, but opinion on this point is by no means uniform. But at least as early as the second century (in the Ignatian *Epistles*) we find the three orders of bishops, presbyters (or elders), and deacons. Presbyterians have both "teaching" and "ruling" (or lay) elders, but whether this distinction existed in the apostolic age is still a mooted question. See PRESBYTER.

Eldon, JOHN SCOTT, Earl of: Lord Chancellor of England; b. at Newcastle, June 4, 1751. He was educated at Oxford, where he gained in 1771 a prize of £20 for an English prose essay. In 1772 he contracted a clandestine marriage with a lady named Elizabeth Surtees, and by this act forfeited a fellowship which he had obtained in the college. He studied law in the Middle Temple, was called to the bar in 1776, inherited £3,000 from his father in that year, and began to practice in the northern circuit. After four years of moderate success, he gained great distinction, and rose rapidly to fame and affluence. He became in 1783 a member of Parliament, in which he supported Mr. Pitt, and showed himself an able debater. He was appointed solicitor-general in 1788, and attorney-general in 1793. During the excitement of the French revolution he prosecuted Horne Tooke and others who were accused of treason, but they were defended by Erskine and acquitted. In 1799 he became chief justice of the court of common pleas, was created Baron Eldon, and entered the House of Peers. On the formation of a new ministry by Mr. Addington in 1801, Lord Eldon was appointed Lord Chancellor. He continued to fill that high office under several successive administrations for a period of twenty-six years, except an interval of nearly a year in 1806–07. His reputation as a judge was very high, but as a statesman his merit was not great. D. Jan. 13, 1838. His brother William was an eminent judge, and bore the title of Lord Stowell. See Twiss, *The Public and Private Life of Lord Eldon* (3 vols., 1844); Lord Campbell, *Lives of the Lord Chancellors.*

Eldo'ra: town; capital of Hardin co., Ia. (for location, see map of Iowa, ref. 4–H); situated on the Iowa river and the Chi., Ia. and Dak. and Ia. Central R. Rs., about 66 miles N. N. E. of Des Moines. It has eight churches, a state reform school, a flouring-mill, planing-mill, potteries, large brick and tile works, electric lights, etc., and is a shipping-point for coal, live stock, and grain. Pop. (1880) 1,584; (1890) 1,577; (1900) 2,233. EDITOR OF "HERALD."

El Dorado, el-dō-raa'do (Sp., the gilded): the fabled king of an equally fabulous Indian city, long supposed to exist somewhere in the northern part of South America. In its most definite form the story described a lake in which was an island with a city marvelously rich in gold, silver, and precious stones. The chief or "king" of the city was daily or periodically anointed with thick oil, in which gold-dust was stuck until he appeared to be covered with the metal. This king was "El Dorado" of the Spaniards, and the name has been erroneously transferred in common language to the supposed city or region which he governed.

This widespread delusion was probably the result of various causes which we can only conjecture at this day. It is quite possible that vague reports of Cuzco and other Andean cities passed from tribe to tribe of the Indians, and were recounted by them to the Spaniards. Or we may explain the numerous stories of golden cities as bits of aboriginal folk-lore, come down from more ancient times, just as the child's tale of a pot of gold under the rainbow is a legacy of the Middle Ages It is even possible that El Dorado may have been a real personage whose wealth was magnified by time and distance. It is said that the Indians about the sacred lake of Guatavita, in the Bogotá highlands, celebrated a strange yearly sacrifice. "On the appointed day the chief smeared his body with balsam and then rolled in gold-dust. Thus gilded and resplendent, he entered a canoe, surrounded by his nobles, while an immense multitude of people with music and songs crowded the shores of the lake. Having reached the center, the chief deposited his offerings of gold, emeralds, and other precious things, and then jumped in himself to bathe" (Acosta, *Descubrimiento y Conquista de la Nueva Granada*, p. 199). But it is not averred that the Spaniards ever witnessed this ceremony, and the story itself may be but a form of the El Dorado myth.

The sixteenth century was a very credulous period, and the cupidity of the Spaniards eagerly grasped at stories of golden cities and rich kings. Tales imperfectly understood were embellished to suit their imagination; and, above all, they constantly asked leading questions, which savages almost invariably answer in the affirmative. No doubt, also, the Indians often concocted stories of distant mines and towns, hoping that their unwelcome guests would go in search of them; or, seeing how the Spaniards loved gold, they invented stories to please them. In 1492 Columbus heard, or thought he heard, of rich mines and cities back from the coasts of Cuba and Hispaniola, and in 1502 he named Costa Rica and Castilla del Oro from similar reports. At Darien Balboa heard of the rich temple of Dabaiba, vaguely located somewhere about the head of the Atrato; the temple, it was said, was lined with gold, and slaves were sacrificed there. In 1512 he led an expedition in search of it; there were others in 1515 and later, and it was long a tempting bait. Some of the explorers found tombs, rich in golden ornaments, but no temple. In 1530 Alfinger marched into the mountains of Venezuela searching for a golden city, and he and most of his men perished. In 1531 Diego de Ordaz explored the Orinoco with a similar object; one of his officers, Martinez, afterward claimed that he had actually been in the golden city, which he called Manoa: and he, it is said, was the first to apply the name El Dorado to the gilded king. It was natural enough that lying reports like this of Martinez should grow up around the story, all the more so that they were readily believed. For a time the mountains of New Granada were the favored region of El Dorado. In 1537 Quesada, marching from Santa Marta, reached the plateau of Bogotá and the country of the Chibchas; soon after he was joined there by Federmann, who had come from Venezuela, and Benalcazar from Quito, all chasing the same golden phantom. The spoil of the Chibchas only whetted their appetites: when it was known that El Dorado could not be found in the highlands, his city was located farther and farther toward the center of the continent, in the great forests of the Orinoco and Amazon. These wilds are almost unknown at the present day, but in the sixteenth century they were traversed again and again by bands of Spanish adventurers. The early knowledge of the Orinoco and Amazon, with their tributaries, was almost entirely due to these expeditions. In 1541 Philip von Huten, starting from Coro, passed clear across the Orinoco basin, and actually reached the country of the Omaguas, near the Amazon, a journey that seems nearly incredible. He failed to conquer the Omaguas, and probably for no better reason they became for a time the guardians of El Dorado. Pedro de Ursua started from Bogotá to find a "golden city of the sun," and his expedition founded the town of Pampluna. In 1560 the same leader was appointed "governor of Omagua and El Dorado," and he started to find his domain by way of the Huallaga and Amazon. Ursua was murdered by Lope de Aguirre, who finally descended the Amazon and reached Venezuela after one of the maddest piratical cruises ever recorded. By this time the myth had taken many new forms. On the southwestern tributaries of the Amazon there were the fabled districts of Enim and Paytiti, said to have been founded by Incas who had fled from Peru, and to have surpassed ancient Cuzco in splendor; these were the objects of numerous expeditions, and even in the eighteenth century they were universally supposed to be realities. North of the Amazon the supposed town of El Dorado was shifted eastward until it reached Guiana. There the Englishman Raleigh searched for it in 1595, believing that he had located this much-desired city in a lake called Parima. Raleigh's expedition led indirectly to the modern colony of British Guiana; and the Lake Parima remained on English maps until Schomburgk's explorations conclusively proved that it was a pond and swamp. The emerald mountain of Espirito Santo, and the Martyrios gold mine, long sought for in Western Brazil, recall the El Dorado myth; while far southward in the Argentine plains, the city of Cesar, with silver walls and houses, was another alluring phantom. It was said to have been founded by shipwrecked Spanish mariners, and even late in the eighteenth century expeditions were sent to search for it.

REFERENCES.—Schomburgk, introduction to *Raleigh's Discovery of Guiana* (Hakluyt Society, 1859); Markham, *Search for El Dorado* (Hakluyt Society, 1861); Winsor in

Narrative and Critical History of America, ii, p. 579; Van Heuvel, *Eldorado* (1844). HERBERT H. SMITH.

El Dorado: city (founded in 1867); capital of Butler co., Kan. (for location, see map of Kansas, ref. 7–H); on Walnut river and Atch., Top. and S. F. and Missouri Pacific R. Rs., 30 miles E. N. E. of Wichita. It has good schools, a carriage-factory, woolen-mill, iron-foundry, extensive magnesian limestone quarries, new-process flour-mills, machine-shop, water-works, gas and electric lights. Pop. (1880) 1,411; (1890) 3,339; (1900) 3,466.

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Eldred: borough and railway junction; McKean co., Pa. (for location of county, see map of Pennsylvania, ref. 2–D); situated on Allegheny river, 20 miles east of Bradford, Pa.; in a coal-mining region. Pop. (1880) 1,165; (1890) 1,050; (1900) 963.

E′lea, or **Ve′lia**: an ancient Greek city of Southern Italy; in Lucania, on the Mediterranean Sea. It was the native place of Parmenides and Zeno. See ELEATIC SCHOOL.

Eleanor of Guienne: Queen of France, and subsequently Queen of England; b. about 1122. She was the daughter and heiress of the last Duke of Aquitaine, and was married in 1137 to Louis VII. of France, with whom she went to the Holy Land in 1147. She was divorced from Louis in 1152, and was soon married to Henry II. of England. It appears that she instigated her sons to rebel against their father (Henry II.), who imprisoned her for fifteen years. She acted as regent while her son, Richard I., conducted a crusade to Palestine. D. in 1203. Despite her wayward character she did much to further poetry and art. She surrounded herself with troubadours and *trouvères*, and many of them have sung her praises. Her daughter, Marie of Champagne, also had the same tastes and interests, and her court at Troyes was at one time the poetic center of France. Revised by A. R. MARSH.

Eleatic School: a group of Greek philosophers, the first of whom was Xenophanes of Elea, who flourished about 530 B. C. While the Ionic school gave its attention to outward nature, and investigated the laws which regulate its progress, the Eleatic philosophers directed their speculations to the idea of Being in itself, which they conceived to be the only object of real knowledge. They regarded as vain and illusory the world of change and succession, which they designated τὸ γιγνόμενον (that which becomes or happens, as by accident). Time, space, and motion they considered as phantasms, caused by the deceiving senses, and incapable of scientific explanation. They distinguished between the pure reason, the correlative of being, and opinion or common understanding, which judges according to the impressions of sense. Parmenides and Zeno were the most celebrated disciples of Xenophanes; the former was the author of an epic poem on the Eleatic and Ionic systems. See PHILOSOPHY, HISTORY OF; Zeller's *Pre-Socratine Philosophy*, vol. i.; *The Fragments of Parmenides* (*Jour Spec. Phil.*, vol. iv.).

Elecampane [corruption of Med. Lat. *e′nula* (Class. Lat. *inula*), *campa′na*; *i′nula*, a plant name, *campa′na*, of the fields]: a plant of the genus *Inula* and family *Compositæ*. The common elecampane (*Inula helenium*) is indigenous to Middle and Southern Europe, and has become naturalized in various parts of the U. S. The root somewhat resembles camphor in taste, and has sudorific and diuretic properties. It contains the principles *helenin*, or elecampane camphor, and *inulin*, which is allied to starch.

Election [from Lat. *electio*, choosing, deriv. of *eli′gere*, select]: in law, the choice of two alternatives; sometimes the right to make such choice. The law frequently imposes upon a party the duty to choose between two inconsistent or alternative rights or claims. This obligation may present itself in all branches of the law, and often occurs as a rule of practice. In a court of law, as distinguished from equity, there may be a case of election where a contract is to be performed in the alternative, as where an insurance company stipulates that in case of loss of a building by fire it may either pay its value or rebuild. In such a case, should the company elect to rebuild, its election would be irrevocable. It may also happen that a creditor will have a right, from the circumstances of the case, to elect one of two persons as his debtor. A case of this kind occurs in the law of agency, when an agent purchases goods on credit for an undisclosed principal; the seller, on subsequently discovering the principal, may elect to regard the sale as having been made to him or to the agent, as he may see fit. An instance of election in the case of real estate is that of dower in land which the husband exchanged for other land. The widow has her choice to take dower in either parcel, but she can not take it in both.

In courts of equity the doctrine of election assumes great importance. The case may occur where alternative benefits may be presented to a person by a will or other legal instrument, or more generally he may be required to choose between a gift made to him and something to which he is already entitled. The duty to choose in such a case is not a positive rule of law, but a matter of equity practice, and is not imperative when this artificial doctrine is not known to be a legal rule by the party to whom the gift is made. The fact of election must be shown by some positive act; and if a party who ought to elect holds two estates under inconsistent titles, there is no evidence of an election having been made. A person under a duty to elect between the retention of his own property and the gift of another, may retain his own without forfeiting the gift, but must make due compensation. Thus if a testator devises an owner of property land of his own, and then assumes to dispose of the property of the devisee, and the latter elects to retain his own property, he does not forfeit the devise, but is required to make compensation to the testator's estate equivalent in amount to the property retained by him. Election in procedure may take place in the choice of remedies; as where an owner has been wrongfully deprived of a chattel, he may elect to sue for its value or for the chattel itself. A court will in some cases require a party to an action to elect as between inconsistent allegations as to the cause of action. T. W. DWIGHT.

Election: in politics, the choice of public officers by those persons who possess the right of suffrage, as distinguished from appointment, which is such choice made by superior officers. Popular elections were held in ancient times, as, for example, in the Roman *comitia* and the Athenian popular assemblies; but soon after the establishment of the Roman empire elections, outside the Christian Church, became obsolete. Elections reappear in mediæval Europe in the choice of representative burgesses, who stood for the third estate. Certain monarchs, as the German emperors and the Kings of Poland, were also elected to their place, but not as popular representatives. In no other European country did the election of representatives become so important in the Middle Ages as in England; and the representative systems of other nations have been chiefly imitations of, and in some cases improvements upon, the English system. Elections are called *direct* when officers are chosen by a direct vote of their constituency; *indirect*, when electors are chosen for the purpose of designating the persons who shall exercise official powers.

With regard to the officers voted for, political elections in the U. S. are distinguished into *local* or *municipal elections*, at which officers for some particular town or locality are chosen; *general* or *State elections*, at which officers for the whole of a commonwealth are elected (the most important of which are the gubernatorial and presidential elections for filling the places of Governor and President); and *congressional* or *legislative elections*, at which members of Congress or Legislatures are voted for. Vacancies in offices are sometimes filled, and the acceptance or rejection of particular laws is decided by *special* or *supplementary elections*. All questions relating to political elections must be fully provided for in the election laws of the State. The great interests frequently at stake at elections naturally give rise to *election frauds*, which have assumed in some countries, and in particular in some parts of the U. S., the most alarming dimensions. In view of them attempts have been made to improve, as much as possible, the existing election laws. Special attention has been given for that purpose to stringent registration laws, requiring every voter to register his name some time before the day of election, in order to enable the authorities to verify his claim to taking part in the election. The *inspectors of elections*, whether appointed or elected, are generally taken from the different political parties which engage in the contest. The excitement which often prevails at political elections sometimes leads to *election riots*. These are of frequent occurrence in England, Ireland, and Greece, but they are almost unknown in France and Germany. As in most cases the instigators and leaders of election riots in the U. S. act under the influence of intoxicating liquors, many States have provided by law that on election days liquor-stores must be closed. When the defeated party believes or claims that the declared majority owes its success to election frauds, the elections are likely to be contested. At elections to legislative assemblies such assemblies ordinarily decide finally on the claims of rival candidates; but in some cases the decision rests with the courts. If a presidential election is contested in a republic, there is danger of civil war, of which, in particular, the republics of South and Central America furnish many examples. The U. S., which, on the whole, have been free from the sad experiences of the South and Central American republics, had in 1873 a conspicuous instance of a contested gubernatorial election and its disastrous consequences in Louisiana, where for several months two rival governors claimed each to be the lawful executive of the State, and tried to enforce his claim, until on May 22, 1873, the President of the U. S. interfered by a proclamation in favor of one. The most serious case of a disputed national election was the memorable Hayes and Tilden contest of 1876, which was decided in favor of the former by an electoral commission composed of five Senators, five Representatives, and five associate judges of the Supreme Court. (See PRESIDENTIAL ELECTORAL COMMISSION.) For information as to presidential elections in the U. S., see Stanwood, *A History of Presidential Elections* (4th ed. 1892). See BALLOT REFORM, NOMINATION, PLÉBISCITE, REPRESENTATIVE SYSTEM, SUFFRAGE, and VOTE.

Election, in theology: See CALVINISM.

Elector [Lat. *elec'tor*, chooser, deriv. of *eli'gere*, select; *e*, out from + *le'gere*, choose]: a title of those German princes who had the right or privilege of electing the Emperor of Germany. There were originally (1256 A. D.) seven—namely, the Electors of Cologne, Mentz, Treves, Bohemia, Brandenburg, Saxony, and the Elector Palatine. The first three were Archbishops of Cologne, Mentz, and Treves. The electors had several important privileges, and a very peculiar position in the empire. They usually chose the heir or near relative of the preceding emperor. As the electoral dignity of the Palatine had been transferred to the Dukes of Bavaria, an eighth electorate was established by the peace of Westphalia in 1648 for the Palatine, which ceased in 1777, when the house of Bavaria became extinct. In 1692 the electorate or dignity of elector was conferred on the Dukes of Brunswick-Lüneburg, who were afterward styled Electors of Hanover. The electors were entitled to all royal dignities and honors except the title of majesty. On the dissolution of the Holy Roman Empire in 1806, the office became obsolete, but the title was retained by the rulers of Hesse-Cassel till 1866, when that state was united to Prussia. The term elector is also applied to each of those persons who, under the Constitution of the U. S., are chosen to elect the President. See ELECTORS.

Electoral College: See CONSTITUTION OF THE U. S., Art. XII., and ELECTORS.

Electoral Commission: See PRESIDENTIAL ELECTORAL COMMISSION.

Electoral Crown, or **Cap**: a crown worn by the electors of the German empire. It was surmounted by two golden demicircles, ornamented with pearls and a golden orb and cross at the top.

Electors: in the political system of the U. S., the persons who are chosen by the people of the several States to elect the President and Vice-President. Each State chooses a number of electors equal to the whole number of members it sends to both houses of Congress. No Senator or Representative, or person holding an office of profit or trust under the U. S., can be appointed an elector. The electors must be chosen on the same day in all the States—that is, on the Tuesday next after the first Monday in November. The Constitution ordains (Amendment XII.) that the electors shall meet in their respective States and vote by ballot for President and Vice-President, one of whom at least shall not be an inhabitant of the same State with themselves; and they shall make distinct lists of all persons voted for as President, etc., and of the number of votes for each; which lists they shall sign and certify, and transmit sealed to the seat of government of the U. S., directed to the president of the Senate. The electors of all the States constitute the electoral college. A majority of the whole number of electoral votes is necessary to elect the President and Vice-President. In 1896 the whole number of electors was 447. By the Act of 1792 the date of meeting was the first Wednesday in December, but this was changed by the Act of 1887, which ordains "that the electors of each State shall meet and give their vote on the second Monday in January next following their appointment" at such place as the State Legislature may direct. The electoral votes are opened and counted on the second Wednesday of February by both houses of Congress, which meet in the chamber of the Representatives. If no candidate has a majority of all the votes, the House of Representatives has a right to choose either of the three persons having the highest number of votes. It was supposed by the framers of the Constitution that the electors would exercise a free discretion and choose the best man for the offices, but the position has lost its importance from the fact that the elector is obliged by usage to vote for the candidate of his party.

Electra (in Gr. Ἠλέκτρα): a daughter of Agamemnon, King of Mycenæ; sister of Orestes, and wife of Pylades. She was sometimes called Laodice. Her story is the subject of dramas written by Æschylus, Euripides, Sophocles, and Racine. The most perfect of the ancient tragedies of "Electra" is that of Sophocles; in this she stimulates her brother Orestes (whose life she has saved from the violence of her father's murderers) to avenge the death of that parent. This he does, with the aid of Apollo. Five other persons of this name are mentioned in the Greek mythology.

Electrical Fishes: fishes having the power of giving sensible shocks of electricity. At least fifty marine animals of very diverse character are known to have this power. Among the best known are several species of *Torpedo* and *Narcine* (of the ray family), one of which is occasionally found on the Atlantic coast of the U. S. The *Electrophorus electricus*, a fresh-water eel of South America, sometimes 6 feet long, has the power of overcoming men, and even horses, by its tremendous shocks. Two species of *Malapterurus* of the African rivers are also electric. Faraday observes that the *Electrophorus* may produce a shock equal to that of fifteen Leyden jars, containing in all 3,500 sq. inches, charged to the highest degree. The force is that due to ordinary static electricity, and readily affords a spark. The *Torpedo* and the electric eel have electric organs intimately connected with the nervous system, consisting of a series of highly vascular cells or hollow prisms containing a watery fluid. Other electrical fishes have a less definite apparatus for this function. It is not known that this remarkable power is of any service to these fishes, except in self-protection.

Electrical Machines: machines for the electrostatic generation of differences of potential, that is to say, for electrification by friction or by electrostatic induction. In frictional machines the body rubbed is a revolving glass plate (in early forms a cylinder or ball rubbed by the hand), passing between rubbers of soft leather to which a dressing of sodium amalgam has been applied (Fig. 1).

In the process of electrification, equal and opposite charges are always generated. In frictional machines the glass plate and the metal parts which gather charge therefrom (combs and prime conductors) become positively, the rubber negatively, electrified. The latter is usually connected metallically to the earth. In a dry atmosphere under such circumstances the prime conductor soon begins

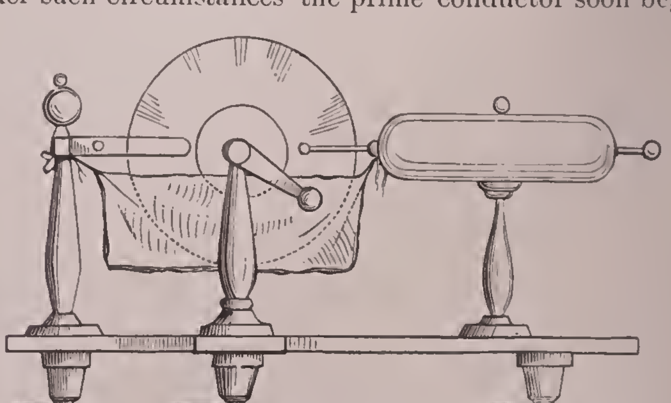


FIG. 1.

to show signs of strong electrification, and after a few rapid revolutions of the plate sparks may be drawn.

In all such machines, however, even under the most favorable conditions, a scarcely appreciable portion of the work done appears in form of electrical energy, the remainder being wasted as heat. For this and for other reasons friction-machines have gone almost entirely out of use, being replaced by a class of machines which produce electrification by electrostatic induction. There are many forms of such apparatus, the best known being the "influence-machines" of Holtz, Toepler and Wimshurst, and the various forms of replenisher devised by Lord Kelvin (Sir William Thomson).

The simplest of all electrical machines of this class is the electrophorus (Fig. 2), which consists of a plate of vulcanite or of some other substance easily electrified by friction, and a metal disk with an insulating handle. When the disk is placed upon the vulcanite surface which has been previously excited by rubbing with fur, it makes contact in three points of support only. All other portions of the metallic surface are in the immediate neighborhood of the charged body. Electrostatic induction brings about a difference of potential between the upper and lower faces of the disk, and when the former has been connected for a moment with the earth and insulated again and the disk removed, it comes away heavily charged. The charge thus obtained is always opposite in character to that residing upon the vulcanite plate (i. e. positive). The source of electrification is the work which must be done to overcome the attractive forces between the oppositely charged faces of the vulcanite and the metal. The quantity of electricity residing upon the former is in no way drawn upon, and the process may be repeated again and again, without exhausting the original charge.

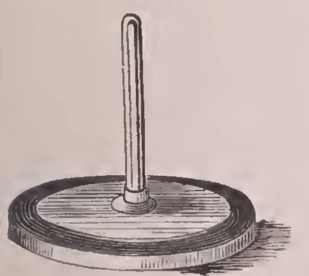


FIG. 2.

This series of operations is known as the electrophorus cycle, and it is of interest, not only because the instrument affords a most convenient method of obtaining small quantities of electricity, but also because it is a cycle, upon the automatic repetition of which all influence-machines and replenishers depend for their action.

The cycle consists of the following steps: 1, a conductor is brought into the neighborhood of a body previously charged; 2, electrostatic induction having brought about difference of potential in the conductor, the repelled charge is carried off by momentary metallic contact with the earth (or sometimes with the opposite pole of the machine); 3, the conductor is removed from the immediate neighborhood of the inducing charge; 4, the charge thus isolated is utilized, or, in the case of most influence-machines, is transferred to a storage reservoir (Leyden jar).

Of the machines based upon the electrophorus process, one of the earliest was that of Holtz (Berlin, 1865).

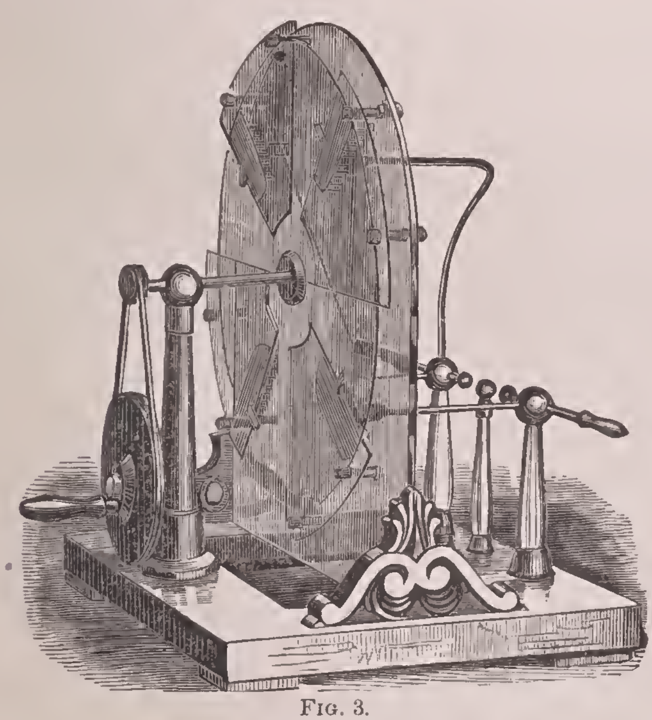


FIG. 3.

The Holtz machine may be selected as a type of the class of instruments to which it belongs. One modification is shown in Fig. 3; the essential parts in the diagram, Fig. 4. A disk of glass ($g\ g'$) is driven upon an axle ($a\ a'$). A stationary glass plate ($n\ n'$) is mounted parallel to the revolving disk and as near to it as possible. Upon the back of the former, and diametrically opposed to one another, are two, or sometimes four, sectors of papers ($s\ s'$). Opposite these, but on the other side of the revolving plate, are the collecting combs ($c\ c'$), which are in metallic connection with the terminals of the machine ($b\ b'$). Each paper sector corresponds to the inducing-plate of an electrophorus.

To bring the machine into action one of the paper sectors s is given a charge of electricity by contact with a piece of vulcanite or glass previously excited by friction. (See ELECTRICITY.) It then acts inductively upon the metallic

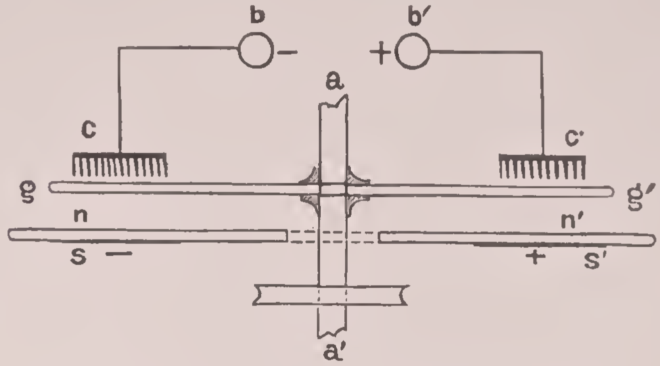


FIG. 4.—The essential parts of the Holtz machine.

comb and terminal, also upon the portions of the revolving disk lying between. The outer face of the latter receives a positive charge from the comb, the inner face gets a similar charge by the inductive action of the sector. In the course of revolution these charged surfaces are brought into the neighborhood of the other sector and comb. Near each sector is a window cut in the fixed plate of the machine, through which a piece of stiff paper from the sector protrudes, terminating in a point which is nearly or quite in contact with the revolving disk. By electrostatic action between the charged faces of the disk and the sector s' on the one side, the paper strip acting as a carrier of electricity, also between the disk and the comb c' on the other, both sectors and comb become positively charged. The disk in turn receives from these negative electricity enough to more than neutralize it, and returns to its original position between the sector and the comb, s and c, carrying a negative charge. Electrostatic induction at this point increases the negative charge of the former, and there is a continuous rise of positive electrification in one sector and terminal of the machine, and of negative electrification in the other, until the differences of potential are such as to produce rapid and brilliant spark-discharges between the knobs $b\ b'$.

The number of modifications of this cycle in the various influence-machines and replenishers is very great; but by none of the more recent devices have more striking and beautiful results been obtained than with the machine of Holtz.

Some description of the effects obtained is to be found in the article ELECTRIC DISCHARGE (*q. v.*).

The difference of potential produced by means of influence-machines is very great (50,000 to 200,000 volts). It has been reached artificially by only one other device, the induction coil. (See INDUCTION COIL.) As compared with machines for the development of electrical energy of moderate tension (dynamo-machines, etc.), friction-machines and influence-machines are of exceedingly low economy. Several attempts have been made to estimate the output of the latter class, and it seems to be well established that under ordinary conditions of working less than one part in fifty thousand of the work expended becomes available in electrical form. (Rossetti, *Nuovo Cimento* (2) 12, 1874.) Influence-machines have played a very important part in the study of electricity, and the literature of the subject is an extensive one. The following are references to some of the most important papers: Volta, *Collezione delle Opere*, 1, p. 118. Töpler, *Ann. der Physik*, 125, p. 469; 127, p. 117. Holtz, *Ann. der Physik*, 126, p. 157; 127, p. 320; 130, p. 287; 156, p. 627. Bertin, *Ann. de Chimie et de Physique*, (4) 13, p. 191. Poggendorff, *Ann. der Physik*, 139, p. 158; 141, p. 161; 154, p. 643. Rossetti, *Nuovo Cimento*, (2) 11, p. 5; (2) 12, p. 89; (2) 14, p. 5. Kohlrausch, *Ann. der Physik*, 135, p. 120. Bouty, *Journal de Physique*, 4, p. 135. The reader is also referred to the following treatises: Mascart, *Traité de l'Électricité* (vol. ii.); Riess, *Die Reibungselektricität*; and Wiedemann, *Elektricität* (vol. ii., pp. 196–244).

E. L. NICHOLS.

Electric Arc: the layer of an incandescent vapor between terminals, not quite in contact, in an electric circuit. The arc is the path of the current between such terminals. Its temperature, which is higher than that attainable by any other artificial means, is maintained by reason of the resistance which the arc offers to the passage of the current. At ordinary temperatures gases are of almost infinite electrical resistance. To establish an arc between two points, therefore, it is necessary to heat the intervening air to a degree at which it is capable of carrying the current. This can be done in some cases by the application of a flame, but the usual method is to bring the terminals together for an instant. Current then flows, and at the point of contact where the resistance is high much heat is generated, the points glow, and the air-film between reaches a temperature such as to make it a conductor. The terminals may now be separated without extinguishing the arc. If, however, neither of these methods is followed, but the difference of potential between the two points is increased to a very high value, the insulating power of the intervening medium will be overcome, and a discharge will take place. With most of the devices by means of which sufficient potential differences can be reached (the induction-coil, influence-machine, etc.) the result is simply a spark which differs from the arc in being of short duration (rarely more than $\frac{1}{40000}$ of a second). After the passage of the spark, the medium, being mobile, will re-establish itself, and no further discharge will occur until the potential difference has risen again to its former high value. The term "electric arc" is applied to the permanent air-path established for the current by one of the previous methods.

The surfaces between the terminals and the arc offer greater resistance to the current than does the arc itself. These then are the regions of the highest temperature. If the terminals are of metal, however refractory, it is at once fused and rapidly volatilized. Almost the only material capable of withstanding the heat developed is carbon in graphitic form, and even this, under the action of the arc, is slowly disintegrated and oxidized, and it is necessary to keep the points at the required proximity either by gravity or by a mechanical device. When an arc is maintained in a continuous-current circuit, the contact resistance at the positive terminal is greater than at the negative. The former, therefore, is always hotter. Both carbons, however, are rendered vividly incandescent, and it is to the light which they emit that the system of illumination known as "arc-lighting" owes its brilliancy. See Electric Lighting.

According to Rossetti, the temperature of the hottest part of the positive carbon of the arc-lamp is 3,900° C., that of the negative carbon 2,450° C. Owing to this difference, also to the electrolytic action of the current, the two terminals are attacked in a different manner, and each assumes a characteristic form. The positive is consumed the more rapidly, in general about twice as fast as in the negative carbon.

Fig. 1 is from a photograph of the arc, made by the writer. Owing to the high actinic value of its rays the arc appears in the photograph relatively brighter than to the eye, but the illustration brings out several of the points already mentioned, viz., the greater brightness of the upper, or positive, carbon, the difference in the shape of the two, and the fact that the incandescent carbons are more important as a source of light than the arc itself. It will be seen that the positive pencil is eaten away at the end, forming a cavity (technically known as the crater), which is the brightest region of all; also that the lower carbon is pointed, with a little crest or nipple. This is formed in great part of carbon which has been detached from the positive pencil, transferred through the arc by the current and deposited there.

In order that an arc may be maintained across an appreciable air-gap, a difference of potential of about twenty-two volts must exist between the terminals. As the voltage rises, the maximum length of arc increases until at fifty volts it is perhaps as much as a centimeter.

Arc-lamps in commercial practice are maintained at a voltage of approximately the latter value.

The resistance of the electric arc varies with the current flowing, but it seems surprisingly small when we consider the materials of which it is composed. With ten ampères flowing and fifty volts between terminals, the resistance (by Ohm's law) is only five ohms. Of this a considerable and nearly constant factor is the "contact-resistance" between the terminals and the intervening gas. It follows that the resistance of the arc is not directly proportional to the distance between the carbons, but is expressed by a formula of the following sort:

$$R_a = r_c + lr_s.$$

Where R_a is the total resistance between the terminals, r_c is the contact resistance, l is the length of the arc, and r_s a quantity which expresses the resistance of the gas layer per unit length.

The electric arc acts like any conductor carrying current. When placed in the magnetic field, for instance, it tends to move at right angles to the lines of force. Since the medium is a mobile one, this tendency is indicated by marked displacement of the arc (as in the well-known experiment of the repulsion of the arc by means of the horseshoe magnet).

In an alternating-current circuit many of the phenomena of the arc differ from those just described. The terminals

Fig. 1.—The electric arc (direct-current circuit).

tend to assume the same shape, they are equally bright, and they are consumed at nearly the same rate. In such circuits the current passes through zero at every alternation, and the arc is extinguished at every reversal; but it is re-established as the current rises, before the air-gap has had an opportunity to cool. The familiar humming of the alternating arc is due to this reignition at each alternation. The fact of the extinction of the arc has been established by photographing it upon a rapidly moving plate.

Fig. 2.—The alternate current arc, photographed on a moving plate (showing the periodic extinction of the arc).

Fig. 2 is from such a photograph, made by Mr. J. C. McMynn (*Trans. Am. Inst. E. E.*, 1891).

The trace of the image of the arc is not continuous, but consists of alternate light and dark spaces, which correspond in time to the period of reversal. The continuous traces above and below the image of the arc are due to the incandescent tips of the upper and lower carbons.

The materials present in the arc depend upon the character of the terminals and of the intervening medium. The arc-spectrum always shows bright lines, which are traceable to the vapors of whatever metals chance to be present. Between carbon points are obtained, besides the lines characteristic of carbon compounds, the sodium lines and lines due to iron and to various other metals.

Aside from its value in artificial illumination, the arc is of importance in metallurgy and in various processes where very high temperatures are essential. For some description of its application, see Electric Light, Electric Welding; also Electricity and Electric Discharge.

E. L. Nichols.

Electric Blowpipe: (1) a device in which the electric arc between carbon pencils is powerfully deflected by means of an electric magnet and given the form of a blowpipe flame. The arc was used in this way by Werdermann for the fusion of especially refractory minerals, etc. (2) The term "electrical blowpipe" was applied by some of the older writers on electricity to the familiar experiment upon electrical convection, in which the current of air from a point attached to the prime conductor or to any highly charged body was made to deflect a candle flame, giving the latter somewhat the appearance of the flame of an ordinary blowpipe. E. L. NICHOLS.

Electric Clocks: clocks in which (1) electricity is the motive power which propels the machinery; or (2) power is obtained from weights or springs, and electricity is used for controlling or regulating the motion.

In some electric clocks there is an electro-magnet, which attracts a soft iron keeper whenever a current passes through it. The keeper gives motion to the clock-hands by an extremely simple arrangement of levers and wheels. The current is made and interrupted by the vibrations of a standard clock, which may serve to give time to any number of secondary electric clocks, even if they are at a great distance from each other.

Bain's clock has a soft, hollow electro-magnet for a pendulum, swinging between the like poles of two permanent magnets, the current in the pendulum being broken and reversed in every swing, so that it is forcibly repelled from each magnet.

Electric clocks are capable of running a long time without attention, but when moved by electricity alone are not very regular in their motion, owing to slight irregularities in the electric currents; but when electricity is used as a regulating power, it is capable of rendering important services in making ordinary clocks do accurate work. For example, an astronomical clock of great precision is connected in the proper manner by telegraph wires with a great number of common clocks, in such a way that signals are sent at given intervals. Now, suppose that any one of the common clocks has gained or lost a small interval of time between two signals, the electric current is made to retard or accelerate the motion just enough to correct the work, and to impart to all the common clocks the precision of the astronomical clock. In some cases the hands of the controlled clocks, whether fast or slow, are set right at frequent intervals by the direct mechanical action of an electro-magnet moved by an electric impulse from the standard clock.

Revised by E. L. NICHOLS.

Electric Column: See DRY PILE.

Electric Discharge: a phenomenon which takes place whenever the dielectric separating two conductors, between which difference of potential exists, breaks down. The result is in general an electric spark due to the heat developed along the path over which equalization of potential occurs. When the conditions are such that a considerable potential difference continues to be maintained after the breaking down of the dielectric, the discharge is termed an arc. (See ELECTRIC ARC.) More commonly, however, a flow of extremely brief duration occurs, occupying, as a rule, but a few millionths of a second.

The medium through which a spark passes may be a solid, a liquid, or a gas. In the first case its path is generally marked by mechanical rupture of the material. In the case of fluids, however, although decomposition takes place (probably by dissociation due to the very high temperatures), the dielectric tends to re-establish itself, so that another spark can not pass until the potential-difference necessary to pierce the fluid has again been reached. It is to this fact that oils, etc., owe their superiority as high-tension insulators.

The spark discharge has as its essential features (1) short duration; (2) a definite path; (3) the production of temperatures along the path sufficient to render gases incandescent and to volatilize metals; (4) a detonation of high pitch, the intensity of the sound depending upon the quantity of electricity discharged.

The color of the spark depends upon the chemical constituents of its path. In air it has a decidedly purple tint, characteristic of incandescent nitrogen; the presence of water vapor and of the vapor of mercury tend to modify the color of the spark in air, rendering it more nearly white. In the presence of vapors of the various metals the color of the spark depends upon the nature of the bright line spectrum of the metal—e. g. sodium (yellow), copper (green), zinc (bluish), etc.

Pressure has marked influence upon the character of the discharge. As the pressure of a gas or vapor through which sparks are passing falls, the discharge is seen to lose its definiteness, the path becomes ill defined, and the brilliancy diminishes.

At low pressures the discharge is no longer a spark, but a continuous or prolonged light, often called by the older writers the barometric light. It takes on a new form, and undergoes a series of most striking and beautiful modifications. Many of these discharges *in vacuo* can be observed by means of a good air-pump and an induction-coil, or even with the aid of the Torricellian vacuum in the top of a barometer tube. Some of the more striking phenomena of electrical discharges in pressures, lying between a few hundredths and a few hundred-thousandths of an atmosphere, are exhibited in the sealed vacuum tubes devised by Geissler, of Bonn. (See GEISSLER TUBES.) Other and still more wonderful results have been obtained at lower pressures, extending to the hundred-millionth of an atmosphere, by Crookes. The radiant heat of these discharges has been measured by the BOLOMETER (*q. v.*).

The duration of the electric spark is measured by means of a revolving mirror. At all ordinary rates of rotation the image of the discharge suffers no widening due to the change of plane of the mirror. At high speeds, however, measurable dilation of the image is obtained, and it is found that within the interval of the life of a single spark we have to do, under certain conditions, such as the discharge of a condenser, with the rather complicated phenomenon known as the oscillatory discharge. This consists of a series of discharges following one another with almost inconceivable rapidity. It has been shown that it is accompanied by a number of *reversals of charge* in the condenser, each one involving a smaller potential-difference than the preceding. The rate of oscillation depends upon the *capacity* of the circuit, the *number* of oscillations that occur before equilibrium is established, upon the *resistance* through which the discharge takes place.

Fig. 1 is from a photograph of the oscillatory discharge by Prof. C. V. Boys (see *Philosophical Magazine* (5), 30, p. 248).

The path of a spark between two points is always that which offers the least resistance. It is, however, rarely a straight line. In air, except when special precautions have been taken to remove all dust particles, the course of the spark is always a broken line. Around good insulators, such as glass, resin, or vulcanite, the discharge will follow long and devious paths through media offering less resistance. Since in general there is one path of less resistance than all others, simultaneous sparks over different paths do not occur. The path of least resistance changes from moment to moment, however, and the impression on the retina of the observer lasts for a considerable part of a second. The effect, therefore, when discharges follow one another rapidly between the terminals of the Holtz machine or induction coil, is that of a bundle of simultaneous sparks.

In Fig. 2 is reproduced a photograph of the poles of a large influence-machine between which sparks were passing. The exposure lasted half a second, during which time eleven successive discharges occurred.

Under certain conditions the discharge through air at ordinary pressures, instead of taking the form of a spark, simulates the discharge *in vacuo*. It becomes almost noiseless, the path is ill defined, the color is a faint bluish or purple, scarcely visible in a well-lighted room. This is the *brush discharge*. The effect to the eye is that *of continuity*, as in the vacuum discharge, instead of the abruptly interrupted character of the spark. Analysis by the method of the revolving mirror, however, indicates that both the brush in air and the discharge *in vacuo* are really made up of well-defined, abrupt discharges of short duration and small intensity, these following each other so rapidly that by persistence of vision they give the effect of continuity.

The phenomena connected with the electric discharge are very numerous and complicated. They have been studied at great length, but many points are still doubtful. The differences in appearance, for instance, between the positive and the negative terminals of a vacuum tube, or in the case of the brush discharge the reason why an insulated zinc or magnesium plate negatively electrified loses charge under the influence of light, while the same plate positively charged is uninfluenced by radiation; why, in the case of the spark, the negative terminal is *hotter*, while in that of the continuous-current arc it is *cooler* than the positive—these and a multitude of other questions are in great measure undetermined. The details of the work already done in this interesting domain of experimental physics are scattered throughout the scientific journals and transactions. Excellent summaries are to be found in such works as Riess's *Reibungs-elektricität*, and in the fourth volume of Wiedemann's treatise, *Die Lehre von der Elektricität.*

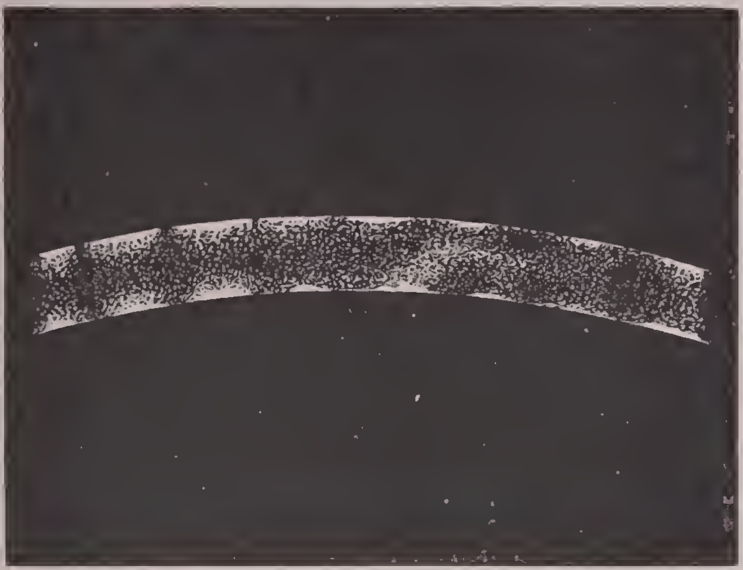


FIG. 1.—The oscillatory discharge (after a photograph by Prof. Boys).

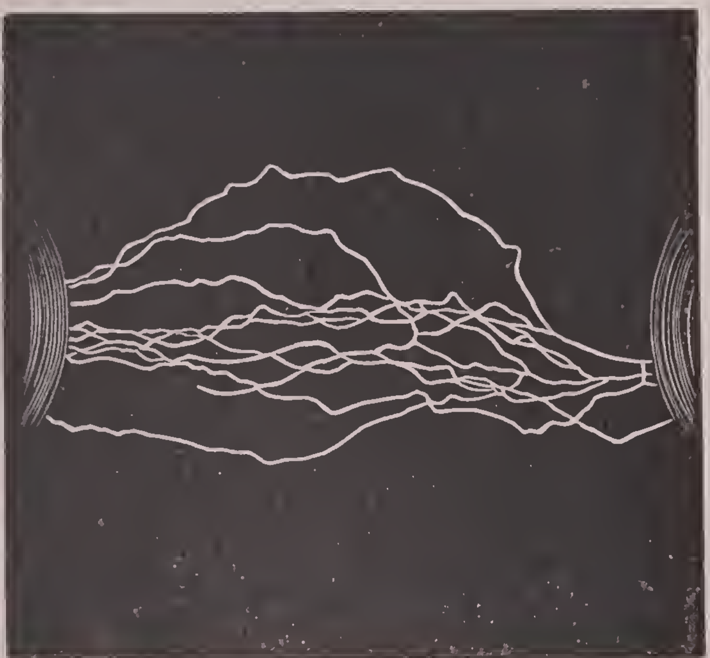


FIG. 2.—Group of sparks passing between the poles of a Holtz machine during half a second (from a photograph).

Electrical discharges occurring in nature are treated in the article LIGHTNING (*q. v.*). For explanation of various terms used in this article, see CAPACITY, CONDENSER, CONDUCTOR, DIELECTRIC, ELECTRICITY, SPECTRUM, and VACUUM.
E. L. NICHOLS.

Electric Eel: See ELECTRICAL FISHES and GYMNOTI.

Electric Furnace: an apparatus in which very high temperatures are attained by surrounding the electric arc, or sometimes a group of arcs, in parallel with carbon, lime, or other refractory substance. The material within which the arc is imbedded should be a poor conductor of heat and of electricity; it should be extremely refractory, and it should be a reducing agent. In some forms of furnace a carbon pot is used, into which is inserted a heavy carbon pencil or a bunch of pencils, the bottom of the pot forming one terminal. The material to be fused is placed between the end of the pencil and the bottom of the pot, surrounded with suitable fluxing material. Another form consists of two groups of pencils dipping diagonally into a furnace box, one group serving as positive, the other as negative terminals. The temperatures produced suffice to reduce the most refractory ores, such as the oxides of aluminium and magnesium. A furnace of small size, consisting of two slender pencils inserted into a cylinder of lime, has been used for the reduction of the rare metals, erbium, yttrium, etc.
E. L. NICHOLS.

Electricity [from Lat. *elec'trum* = Gr. ἤλεκτρον, amber]: the cause of an important class of phenomena, the science of which may be said to have its origin in the experiments of William Gilbert, of Colchester, physician to Queen Elizabeth (1540–1603). The isolated fact, generally ascribed to Thales, that amber when rubbed attracts other bodies was known to the Syrians and Persians at an early day, as well as to the Greeks; but, aside from the statement of Theophrastus that the fabulous mineral lykurion shared with amber the property in question, scarcely an addition seems to have been made to this branch of knowledge for 2,000 years.

Gilbert studied the phenomenon of amber-rubbing systematically, and made out a long list of substances which he found capable of being excited by friction. He was the first to propose the term "electric" by which to distinguish the forces thus brought into play from those due to magnetism. From his time on, the students of electricity rapidly increased. In the seventeenth century there were among its votaries such men as Newton, Boyle, von Guericke, and Hawksbee; in the eighteenth, Du Faye, Symmers, Nollet, and Franklin. Modern electricity began, however, with Cavendish, toward the end of the eighteenth century. His more precise investigations, followed by those of Davy, Oersted, Ohm, Ampère, Faraday, Weber, Henry, and their disciples, made possible the work of the great school of electricians of which Maxwell, von Helmholtz, and Kelvin are the leaders, as well as the important industrial achievements of the closing years of the nineteenth century.

The nomenclature in vogue in electricity is strangely at variance with the present opinions concerning the nature of the phenomena with which the science deals. It is a survival of the time when the two-fluid theory of Du Faye and Symmer and the one-fluid theory of Franklin were the two conflicting "modern views of electricity." We still speak of the separation of the electricities; of the positive (or negative) electricity flowing off to earth, when a body electrified by induction is connected metallicly with the ground. We speak of current, of the direction of the current, of flow and rate of flow. The term *charge* originally conveyed the idea of filling a body with the electric fluid, and *discharge* referred to the supposed escape of that fluid. Terms indicative of the existence of the electric fluid are still used, but it is merely for convenience, and with recognition on the part of every well-informed student that the nomenclature is an artificial one. Electricity, from the standpoint of the present day, is a science which deals with certain transformations of energy. It is the purpose of this article to describe some of the more important of these transformations, and to point out their relation to the phenomena with which other parts of the science of physics have to do. In the course of the discussion it will be necessary to deal primarily with a process called electrification, and indirectly with a large number of important and interesting phenomena which result therefrom.

Electrification is a process which involves the expenditure of energy, the nature of the work done always being such as to bring about a certain *difference of condition* (difference of potential) between neighboring bodies or between parts of the same body. It is not easy to determine precisely in what this difference of condition consists, but there is an analogy between electrification and other physical processes, in which potential energy is produced, which may in some degree aid in the understanding of the nature of the case. The processes in question are those in which difference of temperature is created or difference of level in liquids, or in which a spring is stretched or a chemical compound is broken up. In all such cases there is a tendency for the difference of potential to be equalized. In the equalization, energy in one form or another is always developed, giving rise to the innumerable phenomena which it is the province of the science of physics to describe. When the difference of potential produced manifests itself in certain ways it is classified as electrical, and the process by means of which the potential difference has been produced is called electrification.

Difference of electrical potential may be produced by friction, by induction, by chemical action, by application of heat, by the movement of a conductor in the magnetic field (or by variation in the strength of the magnetic field in which conductors lie), and in other ways. These will be considered in turn, and in connection with each the more important phenomena which characterize the re-establishment of equilibrium will be touched upon. It will be seen that the effects produced by these various methods are not related merely, but are identical; and that the result brought about by electrification is entirely independent of the method employed to produce it.

Electrification by Friction.—Whenever two bodies differing in chemical constitution or in physical structure are rubbed together, difference of potential is produced. One of them is then said to be positively, the other negatively, electrified. The indications of electrification are: (*a*) the attraction of bodies thus oppositely charged for one another; (*b*) the mutual repulsion of bodies similarly charged, or between different parts of the same body, in so far as these have freedom of motion. A typical case is that of glass rubbed with silk. Bodies repelled by glass thus excited are by common agreement said to be positively electrified; those which, like the silk under the above conditions, are attracted by glass, are said to be negatively electrified. The terms vitreous (+) and resinous (—) are also in vogue in describing electrification, the resins, when rubbed with fur or flannel, showing electrification opposite to that of glass.

This phenomenon of electrification by friction is a perfectly general one, and it is found that all known substances can be arranged in a series, such that each member when rubbed with any of those which follow it in the list will be positively excited, and when rubbed with those which precede it will develop a negative charge.

The following list is that given by Faraday in his *Experimental Researches* (article 2,141):

+	
Cat (or bear) skin,	Linen,
Flannel,	White silk,
Ivory,	The hand,
Goose-quill,	Wood,
Rock-crystal,	Shellac,
Flint-glass,	Metals (iron, copper, brass, tin, silver, or platinum).
Cotton.	Sulphur.
	—

Many such lists have been made out, but they do not agree with one another, because mere surface changes will sometimes transfer a substance from one part of the series to another. Thus polished glass and ground glass behave very differently, the one being positive, the other negative, when rubbed with such a material as leather.

Conductors and Insulators.—When by friction, or by any of the processes just mentioned, one portion of a body is brought into a different electrical condition from neighboring portions, the rapidity with which equalization occurs depends upon the character of the substance. In metals complete equilibrium is established almost instantly. Such bodies are said to be good conductors of electricity. Others, where difference of potential equalizes itself very slowly, are poor conductors. Very poor conductors are called insulators. To this class belong certain solids, such as dry glass, nearly all resins and vegetable gums, silk, and pre-eminently quartz; also oils, hydrocarbons, and many other liquids, and at ordinary temperatures the gases. There is no sharp line of division between conductors and non-conductors, but the difference between metals and non-metals in this respect is very great.

The crust of the earth, save in exceptional localities, is a conductor, and differences of potential between neighboring parts are quickly equalized. Under the usual conditions of experiment, bodies which are to be electrified are of necessity in material connection with the earth. If there is metallic contact with the latter by means of a rod or wire, and if the body in question is a conductor, the difference of potential between the earth and the body will disappear at once. Conductors of electricity therefore can be made to manifest electrification as a result of friction only when they are insulated—i. e. when the matter which connects them with the earth is not a good conductor. A body which is itself an insulator, however, may be in metallic connection with the earth at one point, and a high degree of electrification may be produced on its surface not contiguous thereto. The very quality which constitutes it an insulator involves slowness of equalization of potential between its parts. The following are some of the more important phenomena occurring in the case of an insulated conductor which is subjected to electrification:

(1) Electrification of any portion of the surface immediately distributes itself over the entire surface of the conducting body.

(2) Electrification shows itself on the surface only.

(3) Electrification shows itself equally on all points of the surface of a conducting sphere. Where, however, the radius of curvature of the surface varies from point to point, electrification is most marked in regions of shortest radius. For example, if the charged body be egg-shaped, it will appear most strongly electrified at the apex.

This principle extended to extreme cases leads to some very interesting results. If, for instance, the radius of curvature at any point is zero (as at the apex of a perfect cone), electrification would then show itself only at the point, and all other portions of the surface would remain unaffected in spite of every effort to electrify them. An approach to this state of affairs is frequently met with in practice.

Another case of interest is that in which the radius of curvature becomes negative, and the surface concave instead of convex.

Within such cavities the show of electrification is always less than on those portions of the surface which are convex, diminishing as the cavity deepens, until in extreme cases, as on the inside of a metal cup, or, better yet, of a metal bottle, it becomes inappreciable. When, finally, the opening is entirely closed over, the electrification within becomes zero.

That electrification shows itself only on the surface of bodies can be shown in a variety of ways.

If the leaves of a delicate gold-leaf ELECTROSCOPE (*q. v.*) be connected with the interior of a hollow sphere, no divergence of the leaves will show itself, however strongly the surface be electrified. Faraday, in an experiment which has become famous, further demonstrated the absence of electric disturbance within a metallic body by carrying an electroscope into a large box, 12 feet each way, which had been highly charged. The instrument showed no indication of electrification, even when connected with the inner wall, although from without 4-inch sparks could be drawn from the tinfoil with which the box was covered.

That electrification shows itself on the outer surface where the radius of curvature is positive, and not on re-entrant portions, is strikingly indicated by the following apparatus:

A flattened ring (Fig. 1) is mounted upon an insulated foot. Inside and out are suspended gilded pith-balls which hang in contact with the surface of the ring. When the ring is electrified the outer balls, sharing the electrification of the surface, are strongly repelled, but those within the ring show no sign of disturbance.

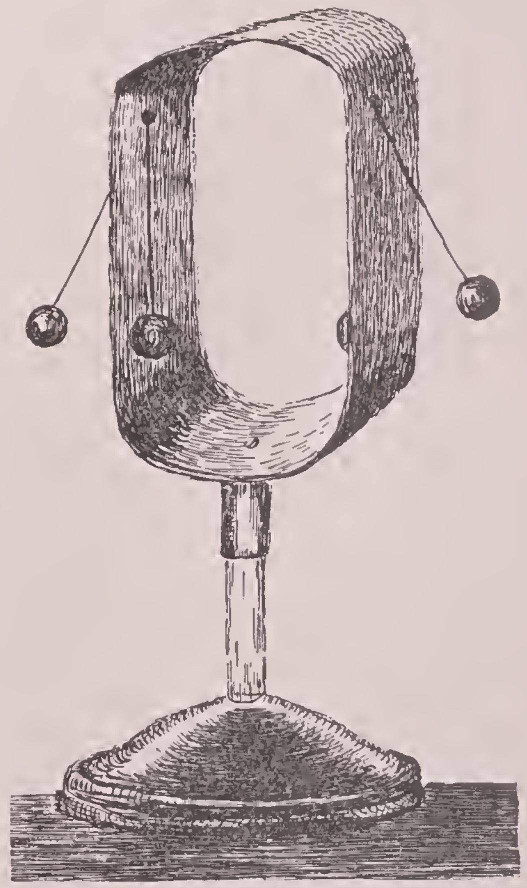


FIG. 1.

The phenomena resulting from the electrification of an insulated body are by no means confined to its own surface. It has already been seen that such a body repels others similarly electrified and attracts those of opposite charge. The forces it is capable of exerting show themselves in another and very important way. It is found that in the neighborhood of such a charged body all other bodies suffer a difference of potential between their parts. Those portions lying nearer to the body in question, which in this case is called the *inducing body*, become electrified in the opposite sense from it. Those portions lying at the greatest distance from the inducing body acquire a charge similar to its own. It is usual to describe this phenomenon by saying that the body in question has been subjected to *electrostatic induction*.

The condition of the body thus influenced is as follows: It carries upon its surface two equal and opposite electrifications. The difference of potential tends toward equalization, but it is kept up by the continued action of the inducing body. If the latter be removed, or if its electrification disappear, instant equalization within the body carrying the induced charges will take place (if it be a good conductor). In the case of a poor conductor the return to the neutral condition will be more gradual. In both cases, however, the restoration of equilibrium will be accompanied by the development of energy in some form.

For a long time these effects were regarded as cases of action at a distance. It is now generally accepted that the action takes place through a universal medium filling all space and permeating all matter; and that the medium possesses properties such as to establish its identity with the luminiferous ether. See LIGHT.

It is usual to express the above condition of affairs by saying that every electrified body possesses a field of force of which it forms a center. Particles of matter within this field tend to move toward or away from a body, according to the manner in which they may be electrified. The paths which they tend to follow are called *lines of force.*

The simplest case is that of a field in which there are only two bodies, a and b, at a distance, d, from one another. The force of their mutual attraction or repulsion is expressed by the equation

$$f = \frac{q_a q_b}{d^2},$$

where q_a and q_b are factors which express the electrical condition of the two bodies. They are called the *quantities of electricity* with which a and b respectively are charged—a name which has come down from a time when there was thought to be an electric fluid.

Considering electrification as a process by means of which a difference of potential is produced, q_a and q_b may still be used, defined as the amount of work done upon the bodies a and b to electrify them.

It is of importance to note that the equation for the force between two electrified bodies is precisely analogous to that which expresses the law of gravitation between any two particles of matter in space, and also to the formula for the attraction or repulsion between two magnetic poles, viz.,

$$f_g = \frac{M_1 M_2}{d^2}, \text{ and } f_m = \frac{m_1 m_2}{d^2},$$

where f_g and f_m are the forces in question, and $M_1 M_2$ the masses or $m_1 m_2$ the strength of the poles respectively.

All three are examples of what are known as central forces, and act inversely as the square of the distance.

Since every material particle in the neighborhood of an electrified body suffers electrical disturbance (insulated bodies having difference of potential between their parts, bodies in metallic connection with the earth coming to a different potential from the latter), and since the production of these changes involves the expenditure of energy which is restored in one form and another whenever the potential differences cease, it follows that the electrification of a body always implies work done, the quantity of which depends upon the amount and the arrangement of matter in the neighborhood.

Whenever a field of force is established within which there is matter to be acted upon inductively, a temporary storage of electrical energy takes place, and in certain cases the amount stored is very large. Apparatus designed for thus storing definite quantities of electrical energy is called a *condenser.*

A condenser generally consists of two or more parallel walls or coatings of conducting material, separated from each other by a layer of some insulating substance called the dielectric. A familiar form of condenser is the Leyden jar. See CONDENSER.

Electrification by Induction.—Electrostatic induction affords the most convenient and effective means of bringing about differences of potential, and it is in the equalization of such differences that many of the most striking phenomena of electricity occur. In the early days of the science, bodies were electrified chiefly by friction. A sphere of glass maintained in rapid rotation and excited by contact with the dry hands of the experimenter (Fig. 2) constituted the celebrated electrical machine of Hawksbee. Later a cylinder was substituted for the revolving sphere, and later still a revolving disk of plate glass, rubbed with leather. About the year 1865 Toepler, and independently Holtz, introduced machines based upon the principle of electrification by induction.

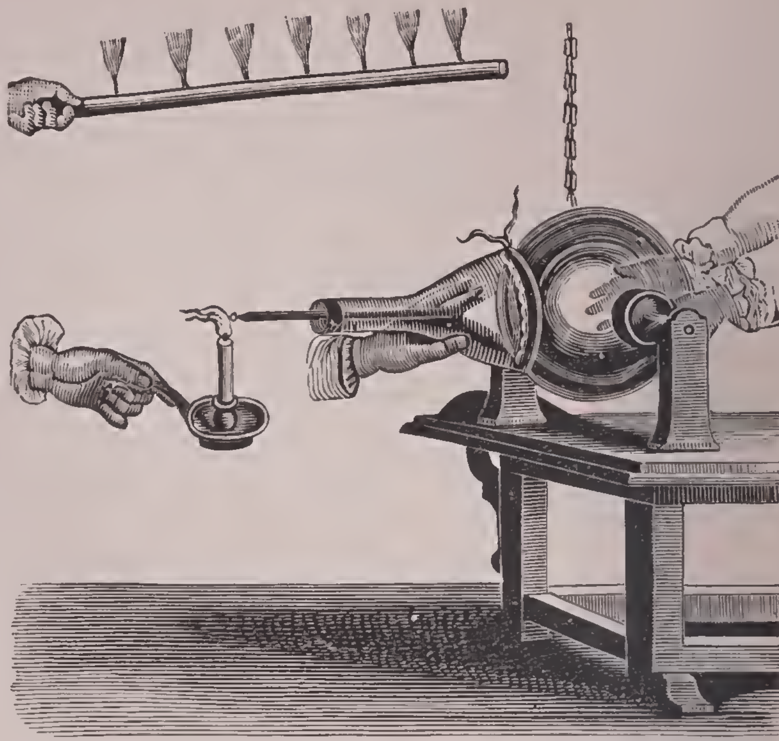


FIG. 2.—Facsimile of an old copper-plate engraving, showing Hawksbee's machine (from the Abbé Nollet's *Lettres sur l'électricité*, Paris, 1764).

Stated in the most general way the process in all such machines consists of the following cycle of operations:

(1) A conductor of electricity is brought very near to some body previously electrified.

(2) The former is connected metallically with the earth.

(3) The earth connection is severed.

If at this point the inducing body and the conductor be separated, the latter will be found to be charged (i. e. to be electrified, and at a different potential from the earth). The sign (±) of its charge will be opposite to that of the inducing body.

This cycle of operations may be gone through with over and over again without depreciation of the inducing charge. The source of the electrical energy developed each time is the work necessary to separate the two bodies of unlike electrification (inducing and induced) from one another.

The simplest form of apparatus by which electrification by induction can be carried on is the well-known electrophorus. The replenisher of Lord Kelvin and the influence-machines of Holtz, Toepler, Wimshurst, etc., are to be regarded simply as devices for the continuous and automatic performance of the electrophorus cycle (just described). See ELECTRICAL MACHINES.

Experiments showing the development of energy during the discharge of electrified bodies are much more numerous than those indicating the expenditure of work in producing electrification. The latter is a gradual, cumulative process, and in the case of most machines the amount of energy converted into heat is so much greater than that which takes electrical form that it is difficult to distinguish the latter. In influence-machines of the Holtz type, for example, the amount of power used when a high difference of potential is maintained between the terminals of the machine is not much greater than for small differences. Determinations of electrical output in terms of the energy applied show a scarcely appreciable efficiency. It is nevertheless frequently possible to detect fluctuations in the speed of such a machine when driven by a small water-motor or other source of power of inadequate regulation, the power necessary to produce rotation rising steadily before each spark and dropping to a small value at the moment of discharge.

Whenever electrical discharge takes place, there is, however, immediate and complete reconversion of the energy of electrification into other forms. The transformation into energy of motion, for instance, may be made to manifest itself in a variety of ways. The experiment of the electrical *tourniquet* is a familiar illustration.

A body (Fig. 3), charged by connection with one of the terminals of a Holtz machine, carries a pair of revolving arms with points.

At each point the degree of electrification is very great, and the atmosphere in the neighborhood is acted upon inductively. It is attracted, then, after electrification is repelled. The result is a convection current of air which moves away from the point in the direction of its axis. A candle held

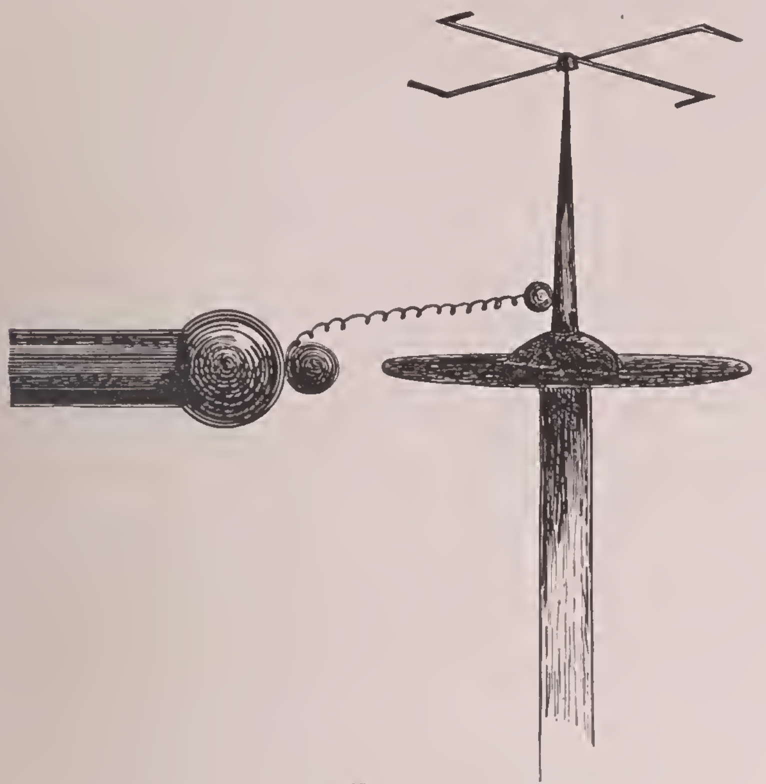


FIG. 3.

before the point will show by the distortion of its flame how powerful this convection current is. The reaction, like the reaction in Barker's mill, tends to thrust the point backward, and motion of rotation results.

A still more striking experiment, showing the conversion of electrical energy into motion, is that of the *reversibility* of the Holtz machine.

If two such machines be taken and their terminals connected by means of a line of wire, as in Fig. 4, and if machine

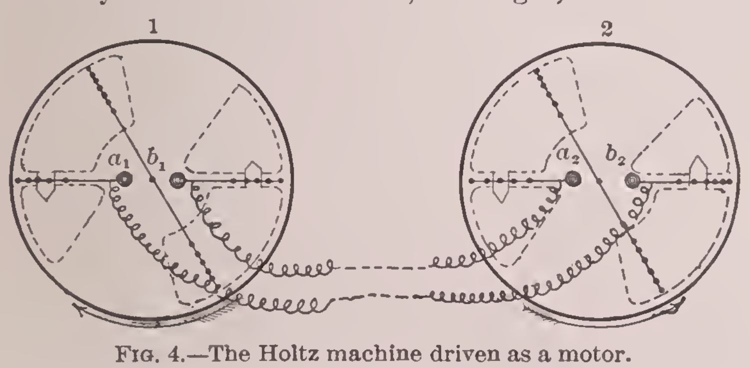


FIG. 4.—The Holtz machine driven as a motor.

1, duly excited, be driven, producing potential differences between its terminals a_1 b_1, which are in metallic connection with the terminals a_2 b_2 of machine 2, the latter will be driven as a motor. The movable plate of machine 2 will travel in the opposite direction from that in which it would be driven when the machine is to be used as a generator. This reversibility of the influence-machine was discovered by Holtz at an early stage of his experiments, and was described by him in 1867.

Voltaic Electricity.—By the means of producing electrification just discussed, i. e. friction and electrostatic induction, great differences of electric potential are produced, resulting in the many brilliant phenomena usually classified under the head of "static electricity."

The invention of the voltaic pile in 1800 opened a new field for research. Volta's experiments, originally intended to throw light upon the discovery of Galvani, which already had attracted the widest interest among physiologists and physicists, were found to lead to so many new phenomena that the discussion of the source of nervous excitation in the frog's leg (of Galvani's experiment) soon became of secondary importance. Physiological effects were the first looked for, but in the hands of Banks, to whom (as president of the Royal Society of London) Volta early communicated his discovery, and of Carlyle, electrolysis within the voltaic cell and by means of it was discovered, together with such phenomena as the production of sparks between the terminals of the pile and the action of the same upon the gold-leaf electrometer. Thus almost immediately the connection between voltaic electricity and electrification by friction was made manifest.

Stated in its most general form, the fundamental discovery of Volta, upon which one of the most important branches of electrical science has its basis, is as follows:

Whenever two conductors of electricity which are capable of acting upon one another chemically are in contact, a difference of potential is set up between them. The usual combination consists of two unlike metals placed in a liquid which conducts electricity and is capable of attacking one of them. Such a device is a *voltaic cell*; a collection of such cells constitutes a BATTERY (*q. v.*). That a difference of potential exists between the metals of a voltaic cell can be determined by connecting them respectively to the quadrants of an electrometer of fair sensitiveness. It will then be found that metals may be classified into two groups: copper, platinum, gold, etc., on the one hand, showing a decided positive (vitreous) electrification when used in a cell in which a member of the other group, zinc, iron, magnesium (and nearly all easily oxidized metals), forms the other terminal. When the first-named terminal is connected with the earth the other shows a correspondingly great negative (resinous) charge.

Electrification by the voltaic method is distinguished by the following characteristics:

(1) It owes its origin to chemical action between the parts of the cell, the energy necessary to bring about the difference of potential and to maintain it being the result of degenerative chemical reactions which lower the potential energy of the system.

(2) With given metals and a given solution separating them, the potential difference is a definite one, both as to direction and amount, being entirely independent of the size and shape of the cell.

(3) The difference of potential between the terminals of a cell can not be reduced to zero by connecting them metallicly. As in the case of two bodies previously charged by friction or induction, continual *tendency* toward equalization of condition manifests itself, but this tendency is overcome by continued chemical reaction within the cell, the reaction being of such a character as to re-establish the potential difference. There results the phenomenon known as the *electric current*, which for convenience is spoken of as flowing from the positive terminal of copper, platinum, or carbon (in accordance with previous conventions established in the study of electrification by friction) through the outer connecting circuit to the other terminal (zinc).

The energy developed in the outer circuit of a voltaic battery may be made to take useful forms—heat, motion of masses, chemical activity, etc. It may be used to establish fields of force—a process which involves the expenditure of energy—or in the production of radiation, and in many other ways. Thus the discovery of the voltaic pile underlies the first really important attempts to utilize electrical energy.

The electrometer, as has already been indicated, serves to show the relation of voltaic electricity to the "static" forms previously known, but it is to another and almost infinitely more sensitive instrument, the GALVANOMETER (*q. v.*), that knowledge of the voltaic current is chiefly due. The *quadrant electrometer* is sensitive to a hundredth of a volt, perhaps; *galvanometers* have been constructed by means of which differences of potential of less than a millionth of a volt can be measured, or currents down to the hundred-thousand-millionth of an ampère.

The laws governing the development of energy in the electric circuit have been very fully studied and precise quantitive relations have been established. The most important of these are Faraday's law of the chemical action of the current, Joule's law of the heating effect of the current, and the laws of electro-magnetic induction. These last govern (1) the production of *motion* by the agency of the electric current, with transformation of energy from the electric to the kinetic form; (2) the production of *current* by the movement of a conductor through a magnetic field, with transformation of kinetic energy into electrical form; (3) the establishment and modification of magnetic fields of force, by which means electrical energy is transferred from one system of conductors to another through space, or into motion, or *vice versa.*

Faraday's laws of electrolysis deal with phenomena occurring when an electric current traverses any liquid (not an element) which is capable of transmitting it.

Under the above conditions the liquid is decomposed. The acid radical contained in it always appears at the terminal whence the current enters the liquid; the metallic component of the liquid always appears at the terminal toward which the current is flowing. Faraday investigated this subject and expressed his results in two laws, which may be stated as follows:

(1) *The chemical action per unit of time in an electrolytic cell is directly proportional to the strength of the current flowing through it.*

(2) *If the same amount of current flows through a series of cells containing various electrolytes, the weight of the materials set free* (called by Faraday the "ions") *in each will be proportional to the chemical equivalent of the substances* (which may be elements or radical groups).

The amount of any ion liberated by the passage of a coulomb of electricity (i. e. by one ampère of current in one second of time) is called its *electro-chemical equivalent.*

The following is a table of the electro-chemical equivalents of some of the more important elements:

Elements (in the order of their atomic weights).	Electro-chemical equivalents (milligrammes per ampère).
Hydrogen	0·01038
Oxygen	0·08283
Sodium	0·2387
Chlorine	0·3671
Potassium	0·4051
Iron (from ferric salts)	0·1934
Iron (from ferrous salts)	0·2900
Nickel	0·3042
Copper (from cupric salts)	0·3279
Copper (from cuprous salts)	0·6558
Zinc	0·3367
Bromine	0·8279
Silver	1·1180
Tin (from stannic salts)	0·3046
Tin (from stannous salts)	0·6093
Iodine	1·3134
Gold	0·6789
Mercury (from mercuric salts)	1·037
Mercury (from mercurous salts)	2·074
Lead	1·071

Of the above, oxygen, chlorine, bromine, and iodine were termed *anions* by Faraday, the others *kations.* The terminal at which the former class, which includes the acid radicals, is set free is called the *anode*; that at which the metallic elements appear is the *kathode.* The current travels through the electrolyte from anode to kathode, and metals therefore may be considered as moving with the current to the point of deposition, while the acid group travels against it.

Familiar examples of the electrolysis of metals are found in the plating of copper, nickel, silver, gold, etc. Where the deposited metal takes crystalline form, very striking

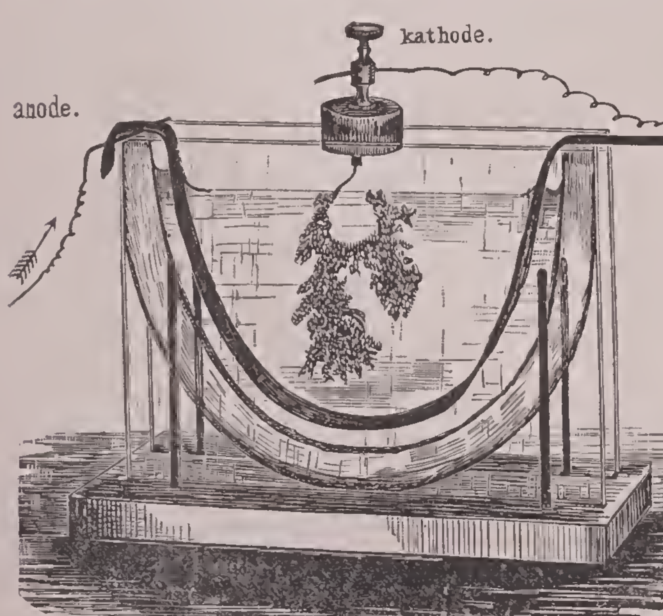


Fig. 5.—The "lead tree."

effects are produced, as in the case of the "lead tree," Fig. 5.

The phenomenon of electrolysis is well brought out in the following experiment:

In a V-shaped tube (Fig. 6) is placed a solution of neutral sulphate of sodium. The platinum terminals *p n* introduce the electric current to the cell and conduct it away. The solution is previously stained purple by the action of litmus. When current passes through from *p* to *n* the following reactions occur, viz.:

$$Na_2SO_4 + mH_2O = SO_4 + mH_2O + 2Na = O + H_2SO_4 + (m-2)H_2O + 2NaHO + 2H.$$

Here we have two sets of chemical changes: (1) Those due to electrolysis, viz., SO_4 set free at the positive pole, 2Na at the negative. (2) Secondary reactions purely chemical. Free SO_4 forms H_2SO_4, setting free O. 2Na at the other pole forms the hydrate 2NaHO, and two parts of hydrogen are liberated. The free acid shows itself by the reddening of the litmus solution in the regions surrounding the posi-

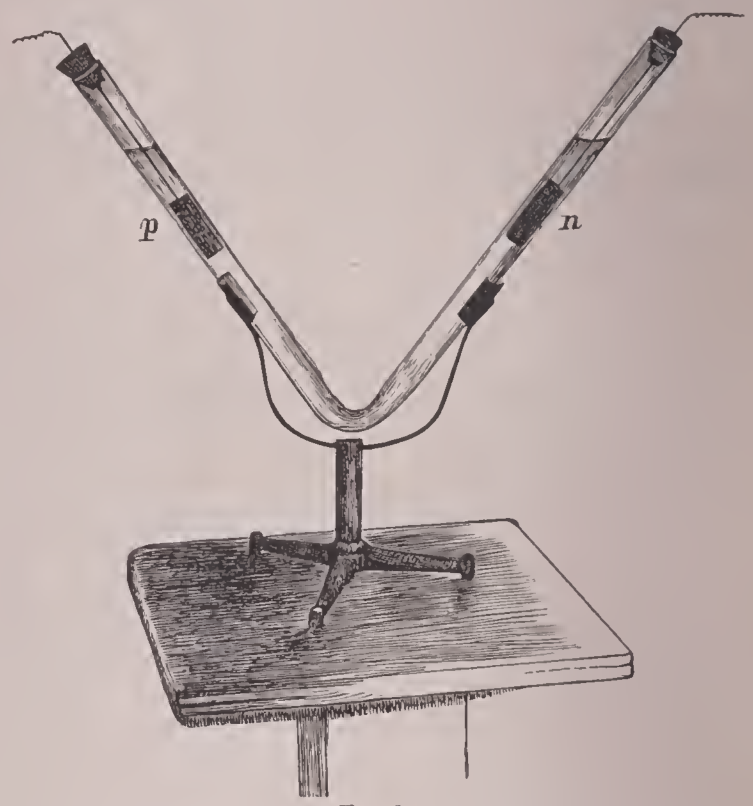


Fig. 6.

tive electrode; sodium hydrate by its alkalinity turns the solution blue in its neighborhood. Oxygen and hydrogen are given off as gases at their respective terminals, and may be collected and tested.

If, after electrolysis has proceeded for some time, the cell is taken out of circuit and the poles connected to the terminals of a galvanometer, that instrument will indicate the passage of current in the direction opposed to that in which the electrolyzing current has been flowing. This current will continue as long as there is a difference between the liquids in the two arms of the cell. The current in electrolysis has broken up a neutral, inactive compound, Na_2SO_4, producing two chemically different and very active substances, H_2SO_4 and NaHO. The separation of these, then, has been accomplished by the expenditure of energy now stored in the cell. Difference of potential will exist between them, and so, by contact, between the platinum poles. Flow of current in direction opposite to that which charged the cell tends to *recombine* the acid and alkali of the two arms of the tube; and it is their recombination that creates the current which the cell has become capable of generating. Such a cell, after the passage of the charging current, is a form of *storage* battery or Accumulator (*q. v.*), giving current as long as the difference between the solutions surrounding the platinum terminals continues.

Voltametry.—It having been established by many critical and precise investigations that the first law of Faraday is rigorously true, it follows that the quantity of electricity transmitted in a circuit (i. e. the integral of the current or product of the average current and the time) may be measured by electrolysis. Any instrument for such purpose is called a Voltameter (*q. v.*).

The electrolyte selected for voltametry must contain as one of its ions a substance insoluble in the liquid, chemically stable and easily collected and weighed. In practice but few materials are used; viz., oxygen and hydrogen (from decomposition of water), silver, copper, and zinc. Silver and copper voltameters are used where precision is desired, since they can be made to give results accordant, within $\frac{1}{10}$ per cent. Zinc has been found to be the best metal for commercial measurements extending over considerable intervals of time. It is used in chemical meters for indicating the energy used in electric lighting of buildings, etc.

Thermal Relations of the Current.—It has already been shown that the electric current is the result of the tendency toward equalization in a circuit, two points in which (for example, the poles of a voltaic cell) are maintained at different potentials.

The current depends upon the resistance of the circuit in such manner that

$$I = \frac{E}{R}$$

where I is the current strength, R the resistance of the circuit, E is the *electromotive force*, a term by means of which is expressed the *tendency* to equalization due to potential differences in the circuit.

This formula is an algebraic statement of the fundamental relation existing in all circuits possessing a constant electromotive force. It is known as *Ohm's law*, from the German physicist of that name, author of a memoir, now classical, upon the mathematical theory of the voltaic circuit (Berlin, 1827.)

Whatever the character of the path traversed by the voltaic current may be, a transformation of energy into the form of heat takes place. During the years in which the doctrine of the conservation of energy was in process of development, this transformation was studied with great care. Joule, to whom the doctrine owed in great part its experimental footing, showed the energy developed in any part of the circuit to be proportional to I^2 and to R. Joule's law stated mathematically is $HJ = I^2Rt$; whence from Ohm's law the corresponding form $HJ = IEt$. In these equations t is the time, H is the heat in calories, and J is "Joule's equivalent," the ratio of the calorie, as a measure of heat expended, to the erg as a measure of work.

Now, since

$$1 \text{ calorie} = 4{\cdot}175 \times 10^7 \text{ ergs, we have}$$

$$\frac{0{\cdot}24 I^2Rt}{10^7} = H \text{ (in calories, nearly),}$$

where R and I are in absolute measure. If current and resistance are measured in the well-known practical units Ampere (*q. v.*) and Ohm (*q. v.*), the inconvenient factor 10^7 disappears; for

$$1 \text{ ampere} = \tfrac{1}{10} \text{ C. G. S. unit of current:}$$
$$1 \text{ ohm} = 10^9 \text{ " " " units of resistance.}$$

The product I^2R (or IE) in practical units is called a *watt*. It measures the energy expended per second in a circuit of one ohm, through which an ampère of current is forced to flow; and when that energy is transformed into heat, it measures the latter in terms easily converted into heat units. The approximate relation of the watt to the calorie and to the erg is as follows:

$$1 \text{ watt} = 0{\cdot}24 \text{ calories per second (nearly);}$$
$$\text{"} \quad = 10^7 \text{ ergs} \quad \text{"} \quad \text{"}$$

Its relation to the horse-power is as follows:

$$1 \text{ horse-power} = 746 \text{ watts (approx.).}$$

It is so simple a matter to measure current and electromotive force, and by their product to express the work done in any electric circuit, that the watt and its multiple the *kilowatt* (1,000 watts) have come into nearly universal use wherever the relations of *electricity* and *power* are to be dealt with.

From the laws of Ohm and Joule many important electrical relations follow. Some of the most obvious are:

(1) In a circuit with fixed electromotive force the current depends solely upon the resistance, and may be controlled and varied through any range by varying the latter. Fluctuations of electromotive force introduce additional factors into the relationship, and instead of Ohm's law there is a law which takes into consideration the *capacity* of the circuit and its *self-induction*. These quantities depend upon the arrangement of the parts of the circuit with reference to each other and to surrounding objects. The nature and rate of fluctuation in the electromotive force are also of influence. The general expression for the energy in the case of fluctuating electromotive force is

$$EIdt = I^2Rdt + LI\frac{dI}{dt}dt + \frac{Idt \int Idt}{C},$$

a differential equation which indicates the fact that the energy of the circuit, EIdt, is expended in three ways. One portion, I^2Rdt, goes to the production of heat in accordance with Joule's law. Another portion, $LI\frac{dI}{dt}dt$, is spent in the building up and in ever-recurring modification of the field of force due to the current. The remainder, $\frac{Idt \int Idt}{C}$, is expended electrostatically, viz., in charging whatever portions of the circuit are (by virtue of their action as a condenser) capable of storing energy in that manner.

Whenever the electromotive force of the circuit becomes constant, the factors of self-induction and capacity disappear, and the equation assumes the familiar form of Ohm's law, $I = \frac{E}{R}$. For full discussions of interesting cases arising under conditions of rapidly changing electromotive force, see Fleming, *The Alternating Current Transformer*; also Bedell and Crehore, *Alternating Currents Analytically and Graphically Treated*, etc.

(2) In a circuit to which Ohm's law does apply, resistance being constant, current will always be directly proportional to the electromotive force. Where the circuit is supplied from a voltaic battery, the electromotive force may be changed, simply by varying the number of cells. If a battery be arranged in series, the positive pole of one cell to the negative of the next, there results the potential rising step-wise from cell to cell, as indicated in Fig. 7.

The total potential - difference upon which the electromotive force of the circuit depends is proportional to the number of cells A, B, C, D, E. It is the sum of the electromotive forces due to these individually.

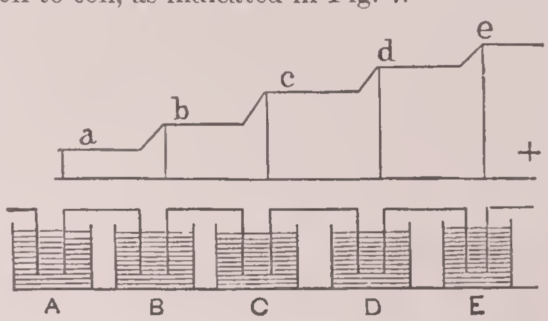


Fig. 7.—Diagram showing the rise of potential-difference in a battery arranged in series.

(3) Circuits in which continuous currents are flowing owe their condition to one or more *generators*, which may be voltaic cells, dynamos, or other sources. Between the terminals of these exist differences of potential. The complete circuit consists of two portions—that within the generator (inner circuit), and that which forms the path along which equalization of potential is taking place (outer circuit). The resistance of both of these must be taken into account

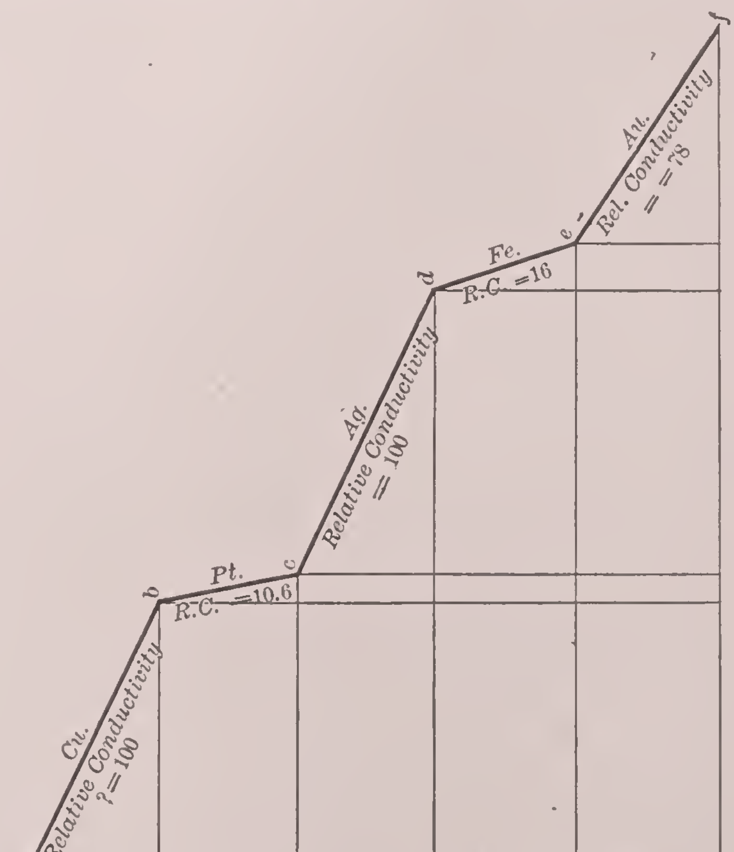


Fig. 8.—Fall of potential.

in calculating current by Ohm's law. Throughout the outer circuit there is continuous fall of potential from the positive pole of the generator to its negative pole. The rate of fall for each portion of the circuit depends upon the resistance per unit of length of the conductor traversed by the current. Through regions of high resistance the fall of potential is rapid; through good conductors of large cross-section it may be inappreciable.

In the accompanying diagram (Fig. 8) a circuit between two points is represented. The total difference of potential between a and f is 100 volts, maintained, say, by a storage battery of fifty cells. This is indicated by the vertical distance between a and b. The fall of potential from a to the successive points b c d e f is represented likewise by vertical distance, the rate of fall by the gradient of the line which connects them.

Abscissas in the diagram represent *lengths* of the various conductors used in the circuit.

The circuit contains:

(1) 20 ohms of copper wire (between			a	and	b)
(2) "	platinum "	"	b	"	f
(3) "	silver "	"	c	"	d
(4) "	iron "	"	d	"	e
(5) "	gold "	"	e	"	f

The cross-sections of these wires are all the same, and their lengths respectively indicate the relative conductivity of the metal. The fall of potential through each piece will be the same, since the resistances are the same, and by Joule's law the amount of heat developed in each (I^2R) per second will be the same. If all other resistances beyond a and f be supposed to be negligible, the current by Ohm's law will be one ampère, the energy developed in each section will be 20 watts, or 4·8 calories per second. In wires of equal diameter the radiating surface will be proportional to the length. The good conductors, copper, silver, and gold, being long and of relatively large surface, will remain cool while carrying current sufficient to raise the temperature of the platinum and iron to points high above the surrounding atmosphere. The difference may be brought out in a striking manner by sending a heavy current through a composite circuit of the kind under discussion. It will be found that the platinum becomes white hot and the iron red hot, while the copper and silver are still barely warm to the touch. This is an illustration of the physical principle made use of in lighting by incandescence (see articles ELECTRIC LIGHTING, ELECTRIC ARC, and GLOW-LAMP); also in heating by electricity.

Resistance, which is one of the factors which enters the equation for Ohm's law, is the reciprocal of *conductivity*, is directly proportional to the length of the conductor, and inversely proportional to its cross-section. Resistance in the diagram (Fig. 8) is measured by the fall of potential through a unit length of the conductor in question, i. e. by the gradient of the lines joining the successive points, a b c, etc. As there is a direct and constant relation between the resistance of a conductor and the heat evolved by the passage of a current, it is evidently possible by using conductors of equal length and equal cross-section to compare the resistances of different substances in terms of heat-units. One of the most ingenious and widely used devices for comparing electrical resistances is that which is known as Wheatstone's bridge, introduced by Sir Charles Wheatstone, and described in the article WHEATSTONE'S BRIDGE (*q. v.*).

Electricity from Heat (thermo-electricity).—The direct production of difference of potential in a metallic circuit by application of heat is perhaps a less important phenomenon than that of the transformation of electrical energy into heat (discussed under heading JOULE'S LAW). It has, however, numerous interesting applications. Whenever two metals are arranged so as to form a closed circuit and the surfaces of contact differ in temperature, a voltaic current will flow through the circuit. The electromotive force, generally very small, depends upon the difference of temperature of the junctions, although rarely in direct proportion to that difference, excepting through small ranges. The electromotive force varies greatly with the nature of the metals in the circuit. For each temperature it is possible to arrange a list of substances so that, when any two of them are made into a thermo element, current will flow through the hot junction from the metal which is first in the series into the other. Such a list is called the thermo-electric series for that temperature. By measurement of the electromotive forces generated by a difference of one degree (centigrade) in the case of the union of each member of the series with some selected metal, the relation of each to all the other members of the list may be expressed quantitatively, and the performance of any given couple may be indicated. The following is such a table:

Thermo-electro series and E. M. F. in volts between each member and the metal lead, when a difference of one degree (centigrade) exists between junctions. (The average temperature of the two junctions is 20° C.)

Bismuth $+ 89\cdot \times 10^{-6}$ volts.	Silver $- 3\cdot0 \times 10^{-6}$ volts.
Cobalt $+ 22\cdot \times 10^{-6}$ "	Zinc $- 3\cdot7 \times 10^{-6}$ "
Mercury $+ 0\cdot418 \times 10^{-6}$ "	Copper $- 3\cdot8 \times 10^{-6}$ "
Lead $+ 0\cdot0 \times 10^{-6}$ "	Iron (soft) $- 17\cdot5 \times 10^{-6}$ "
Tin $- 0\cdot1 \times 10^{-6}$ "	Antimony $- 2\cdot8 \times 10^{-6}$ to $26\cdot4 \times 10^{-6}$ volts.
Platinum $- 0\cdot9 \times 10^{-6}$ "	Tellurium $- 502\cdot \times 10^{-6}$ "
Gold $- 1\cdot2 \times 10^{-6}$ "	Selenium $- 807\cdot \times 10^{-6}$ "

Compiled for other temperatures or ranges of temperatures, other values would be obtained, and certain members, notably iron, would have other positions in the series. This is due to the fact that the electromotive forces are never simply proportional to temperature differences. In nearly all cases, indeed, the current generated in the circuit containing a thermo element will reach a maximum at some definite temperature difference, falling off again as the difference between the junctions increases, and finally being reversed in direction. This phenomenon, in the case of an iron-copper element, is shown graphically by means of the curve, Fig. 9.

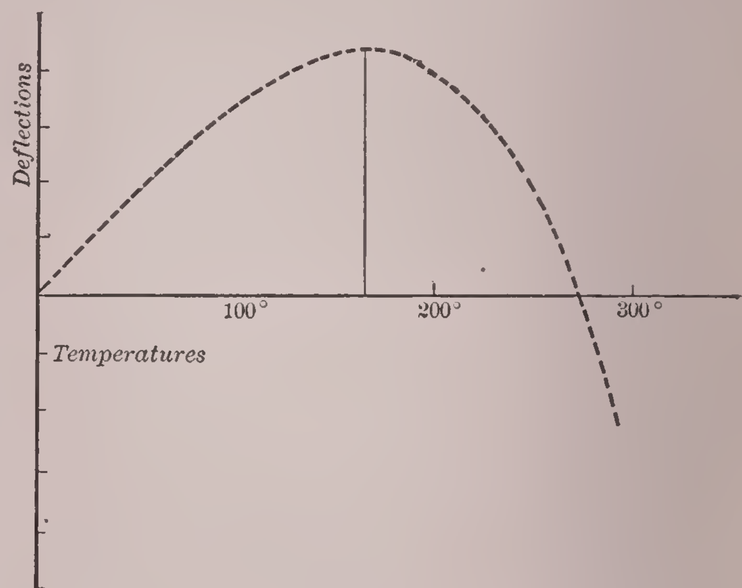


FIG. 9.

One junction of such an element being kept at 0° centigrade (32° Fahrenheit), the other is heated slowly, and the deflection of a galvanometer with which the element is in circuit is followed. Starting from zero, the deflection rises at first in direct proportion to the rise of temperature, then more slowly. It reaches maximum at 169° centigrade (336·2° Fahrenheit) and zero again at 270° centigrade (518° Fahrenheit), after which it continues indefinitely in the negative direction.

Thermo-currents afford a most convenient and delicate means of measuring temperatures. The method is employed especially in cases where the temperatures to be measured are in localities inaccessible to direct observation by means of ordinary thermometers; as for example, in the study of subterranean or deep-sea temperatures, or of the fluctuations occurring within the cylinder wall of a steam-engine, or where the temperatures lie beyond the range of the mercury thermometer, as in the measurement of the heat of furnaces, or of the extreme cold obtained by the liquefaction of oxygen, etc.

Another and even more interesting field is in heat measurements of such character that ordinary thermometers are of insufficient delicacy, as in the exploration of the spectrum. The materials used in thermo elements for heat measurements depend upon the temperatures to be studied. To determine flame temperatures, metals of the platinum group would be selected; where great delicacy is desired the metals at the ends of the thermo-electric series are combined, notably antimony and bismuth; where greater sensitiveness than can be obtained with a single element is necessary, or higher potential-difference is desired, several elements are united to form a THERMOPILE (*q. v.*). When a current is sent through a thermo element from any other source, it is found that, aside from any heating effects coming under Joule's law, difference of temperature between the junctions is brought about, such as to produce a current opposed to that to which the heat is due. For instance, if a bar of bismuth be introduced into a circuit of copper through which a current flows, the junction at which the current passes from the copper to the bismuth will be heated, while the other junction will be cooled. This phenomenon is called, from its discoverer, the *Peltier effect.*

Considered as a generator of the electric current, the thermopile is a machine of low efficiency, the proportion of heat energy transformed to that lost by conduction and correction being very small. By means of certain forms of the apparatus, however (which are described in the article THERMOPILE), very considerable currents may be obtained; and the cheapness of the source of energy, as compared with that available in voltaic cells, sometimes more than compensates for the low efficiency of the method by which it is transformed.

Electro-magnetic Induction.—The fundamental fact in considering the magnetic relations of the electric current is the formation of a field of force surrounding every conductor through which such currents flow. The field exerts forces upon other conductors carrying current and upon magnetic poles. Magnets in the field tend to set themselves parallel to the lines of force, the poles tending to move along the lines, but in opposite directions. These forces are identical as to size, and form a couple which sets the axis of the magnet into the direction of the lines. Conductors bearing current tend to move at right angles to the lines of force, being acted upon because of their own lines, in accordance with a principle to be stated later. The classical observation of the action of an electric circuit upon magnets is that of Oersted (1819), which has been formulated by Ampère in the following manner: "If the observer imagine himself in the circuit, swimming with the current and facing the magnetic needle, the north-seeking pole of the latter will always be deflected to his left hand."

The presence of the field of force around a conductor may be shown by means of iron filings, following the meth-

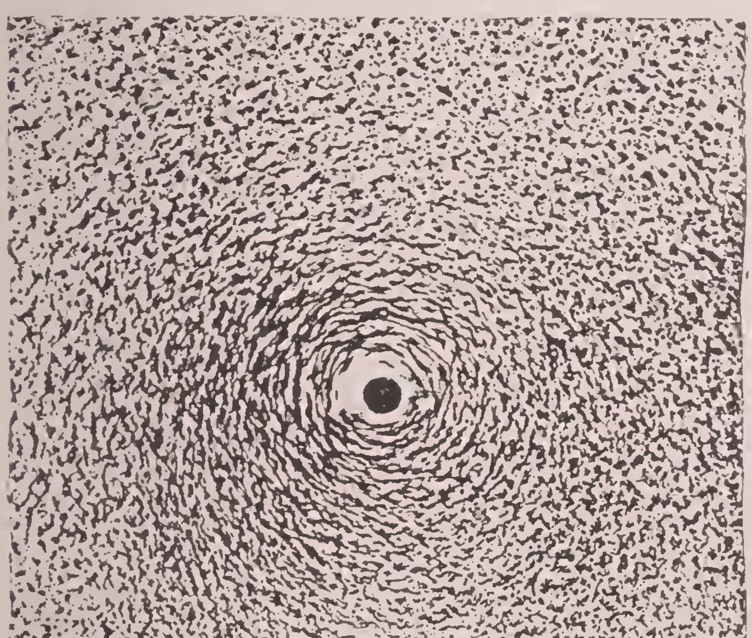


FIG. 10.

od commonly used in the study of magnetic fields. The lines of force are closed curves surrounding the conductor. In the case of a straight wire situated in a medium of uniform permeability, they are concentric circles, the planes of which are at right angles to the axis of the wire (Fig. 10). Lack of homogeneity in the medium will distort the lines, but they always remain closed curves. Fig. 11 shows the distortion of the field by the introduction of a piece of iron into the neighborhood of the conductor.

Fig. 12 shows the character of the field around a wire carrying a current, when the conductor is in the axis of a nearly complete ring of soft iron. It will be noticed that the lines of force are everywhere diverted from their normal position as concentric circles around the wire, and that they tend to pass through the iron rather than through the surrounding medium. Figs. 10, 11, and 12 are directly from photographs of the magnetic field, made by a modification of the ingenious method described by Houston and independently by Thwing in 1892.

It is interesting to compare the electro-magnetic field surrounding a cylindrical conductor carrying current with

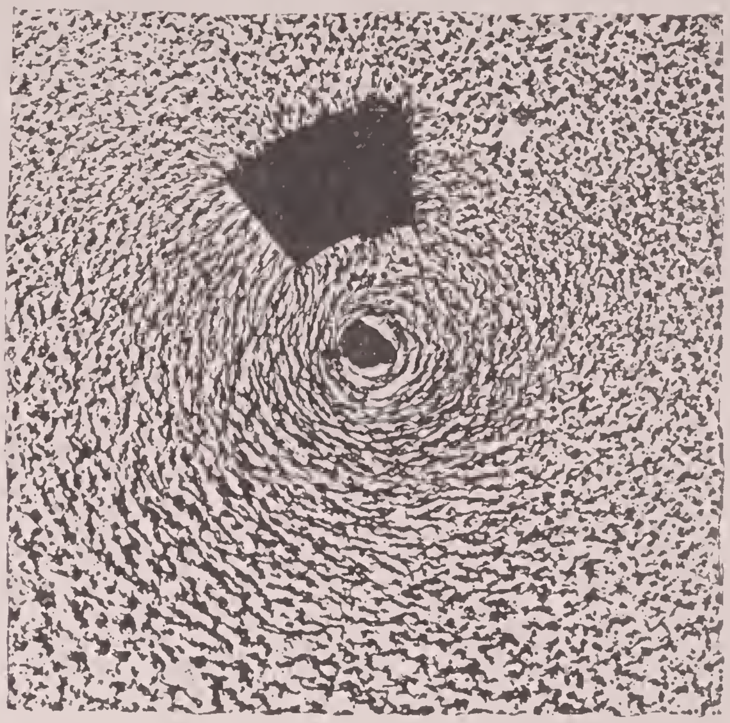


FIG. 11.

the electrostatic field of a cylinder charged to high potential. The lines of force in the latter case are radial. In the electrostatic field electrified particles tend to move along the lines of force, either away from or toward the body to which the field is due. In the electro-magnetic field, magnet poles tend to move along the closed lines of force as just stated, but conductors move at right angles to the lines in directions determined by the direction in which the current is flowing.

All cases of the movement of conductors in the magnetic field, as well as of the movements of magnets near other magnets or near voltaic circuits, may be dealt with by taking advantage of the following assumed properties of lines of force:

(1) Lines of force in the same direction repel each other, and *vice versa.* (2) The direction in which a north-seeking

FIG. 12.

pole is urged along a line of force is taken as the positive direction. From Ampère's rule for the deflection of the needle and the above, it follows that to an observer looking along a wire in the direction of the current lines of force have the clockwise direction, and in a wire carrying current toward the observer the direction of the lines is counter-clockwise (Fig. 13).

From the repellent and attractive forces between lines, it follows that the conductors *a* and *b*, carrying current in the same direction, will be drawn together, while *b* and *c* will be repelled.

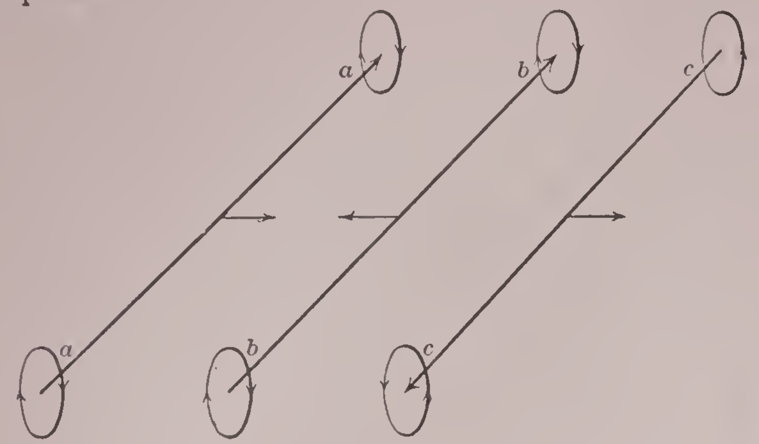


Fig. 13.

This *mutual action of currents* was observed by Ampère, who stated his results thus:

Ampère's Rule.—(1) Currents in parallel circuits attract each other when flowing in the same direction, and repel when flowing in opposite directions.

(2) Circuits making any angle with one another tend to become parallel with the current flowing in the same direction through them.

It is usual to attribute these forces between circuits, and the analogous effects which occur when wires carrying current are brought near to magnets or when one magnet is in proximity to another, to the mutual action of the two fields of force. The effect is entirely independent of the source of the fields, and the movement which will tend to be produced may be predicted whenever the directions of the two systems of lines of force are known.

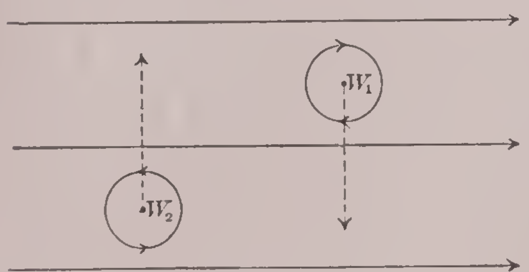


Fig. 14.

Thus a wire (w_1, Fig. 14) normal to the paper and carrying current away from the observer, in the uniform field of force represented by the long, parallel arrows, will tend to move downward. Wire (w_2) carrying current toward the observer will travel upward. Upon this reaction is based one of the most important of electrical devices—the motor. See Electric Motor.

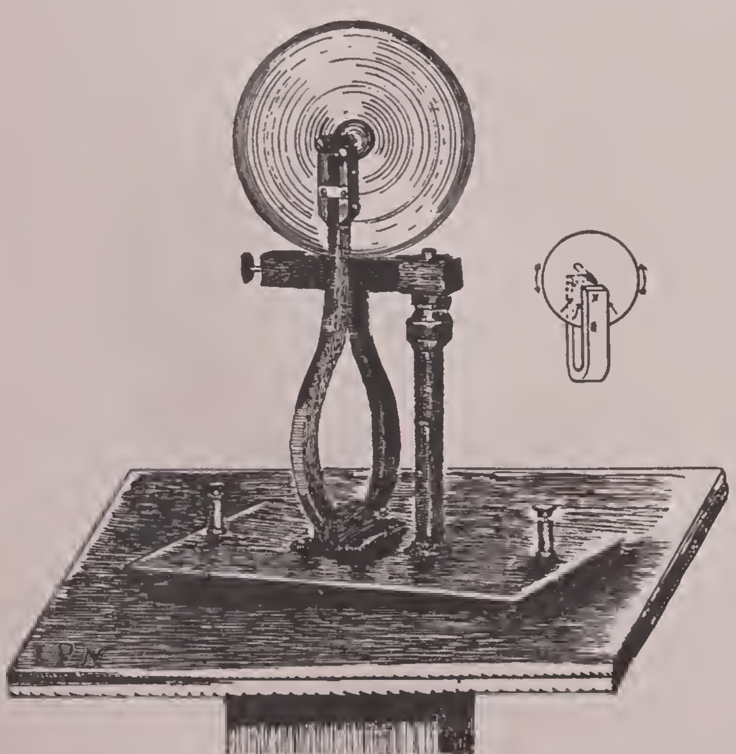


Fig. 15.

Faraday's disk motor is an application of the principle in an exceedingly simple and instructive form.

Between the poles of a horseshoe magnet (Fig. 15) is mounted a thin disk of copper, its axis parallel to the lines of force, so that the sector vertically below the axis is in the field. At its lowest point the periphery of the disk dips into a trough of mercury. If current be sent through the disk, entering through the mercury and leaving by way of the axle, the lines of flow will be vertical and at right angles to the magnetic field, which will act upon that portion of the copper which carries current, driving it out of the field in the direction indicated by the arrow. The result is a rapid rotation of the disk, the direction of which depends upon the direction in which current passes through it and the polarity of the magnet.

Even the earth's field exerts such action upon every conductor which carries current. The effect is shown in a striking manner by the apparatus shown in Fig. 16.

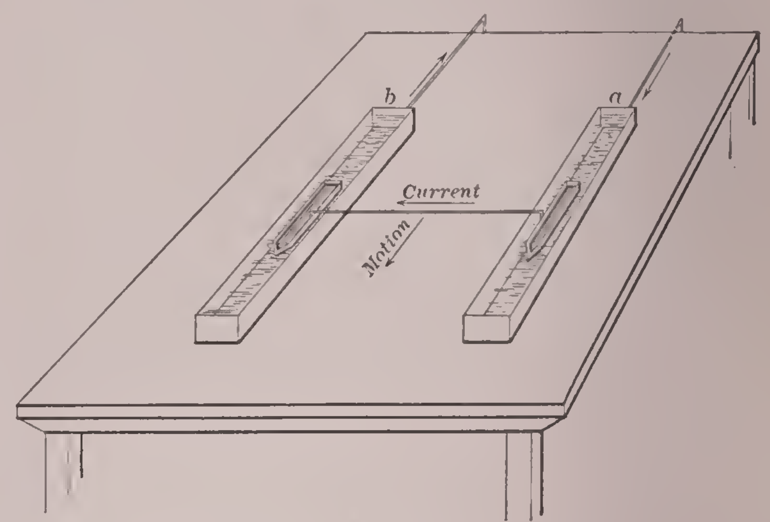


Fig. 16.

Two parallel troughs of copper are filled with a conducting liquid, preferably an acidulated solution of copper sulphate. Two boat-shaped copper vessels are joined by a rod of the same metal, forming a sort of catamaran. This double boat is allowed to float in the two troughs as indicated in the diagram. Current introduced at *a* will flow by means of the connecting bar to the other trough, finding exit, and returning to the battery at *b*. By the action of the earth's magnetic field upon the connecting bar the boats will be driven from end to end of the trough at considerable speed.

The application of the general principle to this case may be seen by reference to Fig. 17, in which *w* is the conductor between the boats seen in cross-section, the current flowing from the observer. The vertical component of the earth's magnetism *v v*, acting upon the lines of force surrounding the wire, tends to drive the latter in the direction of the dotted arrow *a*.

Thus far the case of straight wires has been considered. Conductors are frequently arranged so as to form a cylindrical coil (helix or solenoid). When current traverses such a coil, the lines of force unite to form a single set. They enter the coil at the end in which the current viewed from without axially travels clockwise, and issue from the other end. Such a coil, hung from its center, its axis horizontal and free to rotate about a vertical suspension, will set itself axially in the magnetic meridian when current is sent through it. To an observer looking northward toward the south-pointing end of the coil the current then flows clockwise.

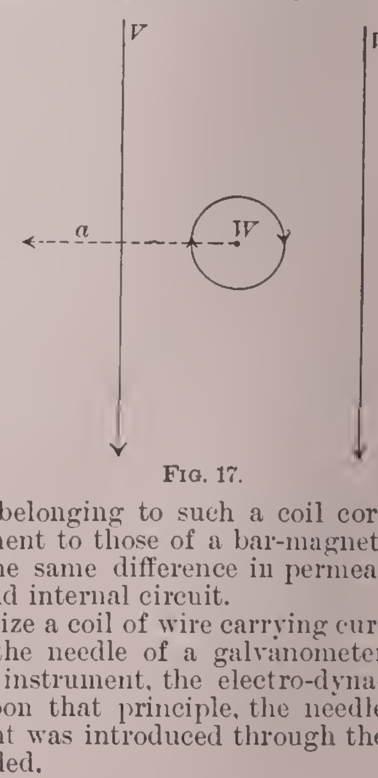


Fig. 17.

The system of lines of force belonging to such a coil correspond precisely in arrangement to those of a bar-magnet, excepting that there is not the same difference in permeability between the external and internal circuit.

It is, indeed, possible to utilize a coil of wire carrying current instead of a magnet for the needle of a galvanometer (*q. v.*). Weber's well-known instrument, the electro-dynamometer, was constructed upon that principle, the needle being a coil into which current was introduced through the wires by which it was suspended.

By introducing a core of iron into the coil, the carrying capacity for lines may be increased many fold, with relative increase of the outer magnetic field. Such an arrangement, indeed, constitutes an electro-magnet. The performance of the electro-magnet is further discussed in MAGNETISM OF IRON (*q. v.*). It is sufficient to note here that the function of the iron core is simply to *increase the magnetic conductivity of the region within the coil*, and that a helix without iron is as truly a magnet as a bar which has been previously magnetized (permanent magnet), or as one in which the polarity is maintained by the action of a coil surrounding it (electro-magnet).

The movement of an electric conductor through the magnetic field, like most phenomena involving transformation of energy, is reversible.

The reversed process may be stated in general terms as follows: Whenever a conducting body is moved in a magnetic field in such a direction as to cut lines of force, there is set up within the moving body a current of such direction as will oppose the motion. Since parallel lines of force in the same direction repel each other, the current induced by any movement of the conductor must create lines of force around the latter, which (on the side toward which the movement takes place) are *parallel to those of the field and in the same direction.* In Fig. 18, v_1 and v_2 are the velocities both as to direction and magnitude, with which the wires w_1 and w_2 are moved through the field. The induced current in w_2 due to this motion will flow toward the observer; in w_1 it will flow away from him. Where the direction of the movement is not normal to the lines of force, the component of the velocity, which is at right angles to the lines, is to be considered.

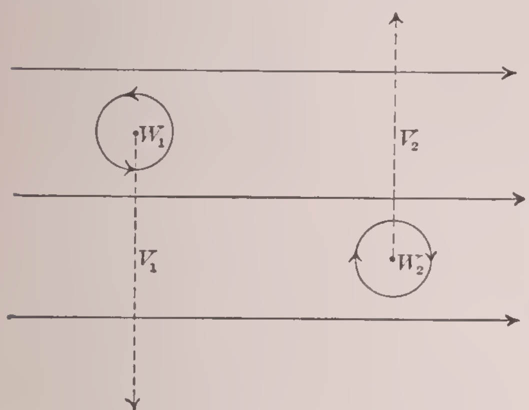


FIG. 18.

The movement of bodies in a magnetic field produces primarily difference of potential between their parts, and consequently electromotive forces and current. The induced electromotive force is proportional to the number of lines cut by the conductor in a unit of time, i. e. to the normal velocity-component, to the strength of the field, and in uniform fields to the length of the conductor measured at right angles to the lines.

Currents thus produced are *induction currents.* They last only during the motion which induces them, and depend upon that motion for their direction and magnitude in the manner stated above.

The DYNAMO-ELECTRIC MACHINE (*q. v.*) is a device for utilizing the principles just laid down for the purpose of generating current. It depends upon the movement of conductors through strong magnetic fields after methods which are discussed at some length in the article just cited. One of the simplest forms of dynamo is the Faraday disk (Fig. 15). When a *current* is sent through the disk it becomes a *motor*, as has been noted already. When *driven through the field*, on the other hand, there will be difference of potential between periphery and axle, and when these are connected metallicly current will flow through the outer circuit. The direction of this current, which will be of such direction as to oppose the motion of the disk, may be deduced from the principles already enunciated.

The great economical importance of the dynamo-machine lies in the fact that it enables the engineer to transform energy of motion directly into electrical form, instead of being obliged to utilize energy derived from the chemical reactions between the expensive materials of the voltaic cell.

It is shown in the article ELECTRIC LIGHTING (*q. v.*) that the development of that great industry depended upon the perfection of the dynamo, and the same thing may be said of every application of electricity involving the use of any considerable power.

The method of cutting lines of force which is used in the dynamo consists in the rapid revolution of a coil or set of coils of wire (the armature) between the poles of a magnet. At first permanent magnets were used. Machines with such magnets are classed as magneto-generators. Fig. 19 shows a well-known early type. Later, electro-magnets were introduced on account of the much stronger field obtainable. The current to excite the electro-magnet in early forms was derived from some external source, then from the dynamo itself. An intermediate type, shown in Fig. 20, carried a small magneto-generator upon the yoke to magnetize the coils of the large machine. This form of dynamo was therefore "separately excited" at first and then became "self-exciting." It was found in practice that nearly all dynamos carried sufficient residual magnetism in their magnet cores to render them self-exciting from the moment of starting. Extraneous means of magnetizing the fields of dynamos therefore fell into disuse.

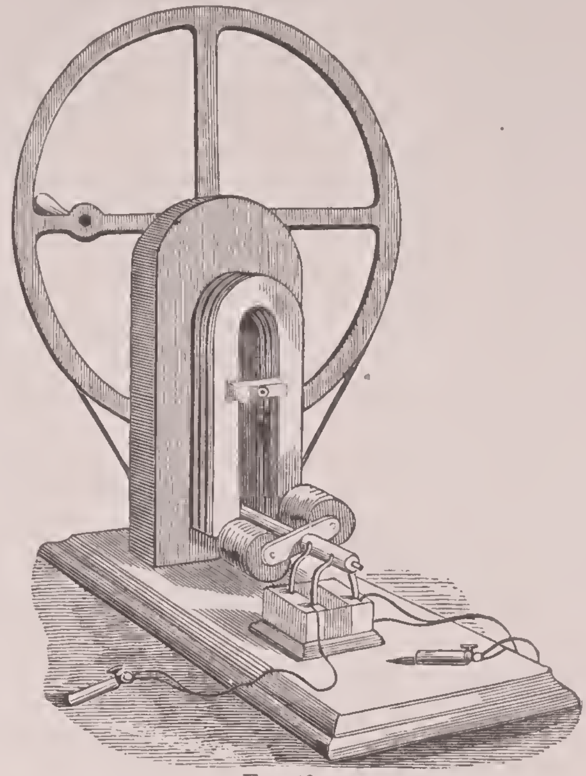


FIG. 19.

To induce currents in a conductor in the magnetic field it is not necessary to move the conductor. Analogous effects may be obtained by causing the field itself to fluctuate in strength or to suffer any rearrangement of its lines. The following is a typical case: Within a coil of wire, and having the same axis, is a second coil. If the inner coil be brought into circuit with a battery, current will flow through it giving rise to lines of force, which in surrounding it will embrace the outer coil also. The effect upon the latter is the same as if it had suddenly been brought from a distance into a field previously formed. There is a very rapid cutting of the lines of force by the outer coil, which induces current during the brief period necessary to the establishment of the field. The entire phenomenon is over in a small fraction of a second of time, the precise interval depending upon the conditions of the circuit. Fig. 21a is from a photographic record of what takes place when current is suddenly sent into a coil of 70 ohms resistance, the impressed electromotive force being 15 volts. During the period of time covered by this curve, between *a* and *b* there will be induced current flowing in the secondary (outer) coil. Its time curve (*c d*, Fig. 21a), however, will not be like that of the primary. It will reach a maximum at the instant when the *rate of change* in the primary is greatest, i. e. when the establishment of the field was taking place most rapidly.

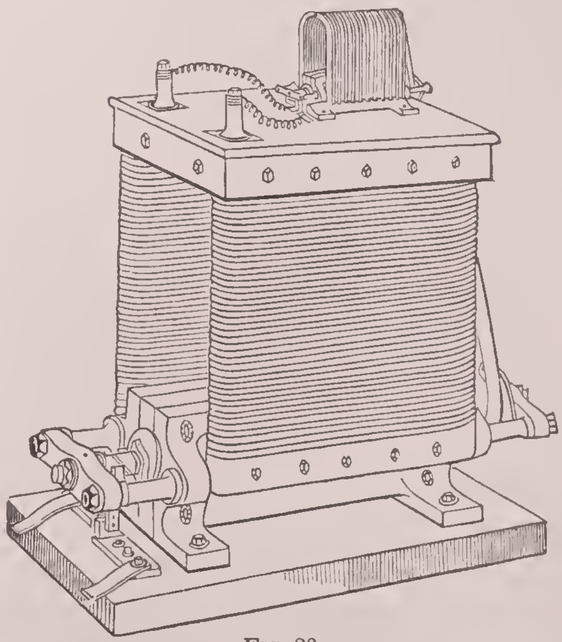


FIG. 20.

The direction of the induced current may be derived from the consideration that the establishment of the field is equivalent to movement into the field, i. e. into the neighborhood of the primary coil, so that the *induced* current which

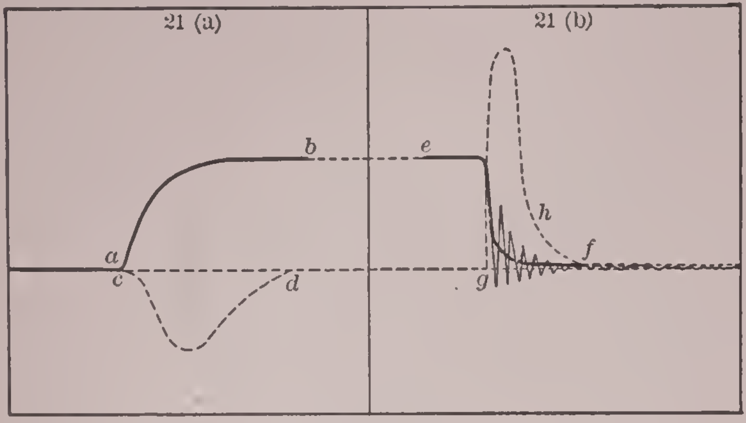


Fig. 21.

opposes the motion must be in a direction opposite to that in the primary. The law may be stated thus:

In neighboring wires the introduction of current into one produces an opposite induced current in the others, the duration of which corresponds to the interval required to completely establish the field of force due to the primary current.

The instant that the primary current has reached its normal value all induction ceases. Let the current be stopped, however, by breaking circuit, and a disappearance of the field of force follows, which is equivalent to the removal of the secondary circuit to a distance, and which induces a current to oppose such motion.

In general, therefore, *in neighboring wires, one of which carries current, the effect of breaking circuit is to induce current in the others, the direction of which is the same as that of the primary, and the duration of which is the interval necessary for the complete disappearance of the field of force due to the primary current.*

The duration of these induced currents is a question involving the resistance, self-induction, and capacity of the two circuits; also the character of the medium within which the field must be established or destroyed. The complete discussion lies quite beyond the scope of this article; it may, however, be noted as of some practical import that the rise of the primary current is in general less rapid than its decadence, and that therefore the induced current rises to a higher value, and is of shorter duration in the latter case. For example, the photographic record of the dying away of the current in the 70-ohm coil, already referred to, when circuit was suddenly broken, is shown in Fig. 21b (curve *e*, *f*) and the induced current by the dotted curve (*g*. *h*.).

These photographic traces (*a b* and *e f*) were obtained by the movement of a mirror attached to the plate of a telephone receiver, according to the ingenious method devised by Dr. Fröhlich, of Berlin (1890–91).

The oscillations shown in the curve *e*. *f*. are the natural vibrations of the telephone plate upon being suddenly released from tension. The heavy curve intersecting them represents the curve of current. The phenomena arising when a voltaic circuit is opened or closed are not always of the simple character shown in these two diagrams. It is found, for instance, that when the capacity of the circuit bears certain relations to the resistance and self-induction, the rise of current or its decadence will be *oscillatory*, with corresponding oscillations of induced current in the secondary circuit.

Electro-magnetic induction is a phenomenon involving the transformation of energy. The mere establishment of an electro-magnetic field of force, like the creation of an electrostatic field, involves the expenditure and storage of energy, to be utilized when the field disappears again. Every movement of a conductor through a field meets with resistance, the surmounting of which requires the expenditure of energy equivalent to that which is represented by the induced current. The induced currents, for example, which circulate in a block of metal driven rapidly through the magnetic field are transformed into heat under Joule's law. If the Faraday disk (Fig. 15) be driven between the poles of a powerful magnet, it will soon rise in temperature above the boiling-point of water. A strip of copper mounted to oscillate between the poles of such a magnet (see Fig. 22) will swing freely so long as the magnet is not in circuit, but when the field is established, powerful eddy currents are set

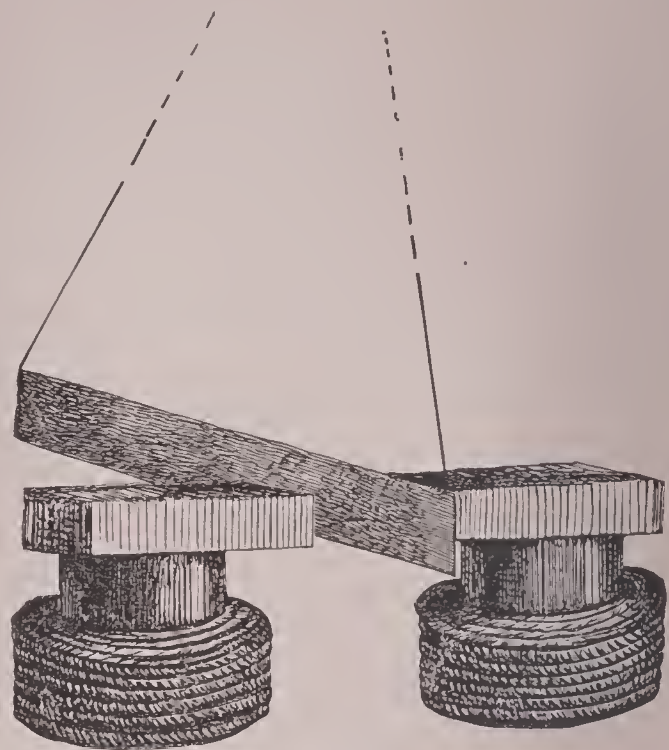


Fig. 22.

up within the copper, resisting its motion. Whatever be its amplitude of vibration, the strip will be brought to rest within the period of a single oscillation. The experiment is a most striking one, the motion of the pendulum being checked as if by passing through some viscous medium. These eddy currents, or Foucault currents (after their discoverer), are a serious source of loss in many forms of electrical machinery. They can be guarded against in a great measure by lamination of those parts of the machine which cut lines of force.

The induction coil (Ruhmkorff coil, spark coil) is a form of apparatus for the utilization of the induction effects produced by making and breaking circuit. It consists of a primary and a secondary coil, one within the other, the common axis of the two being occupied by a core of iron

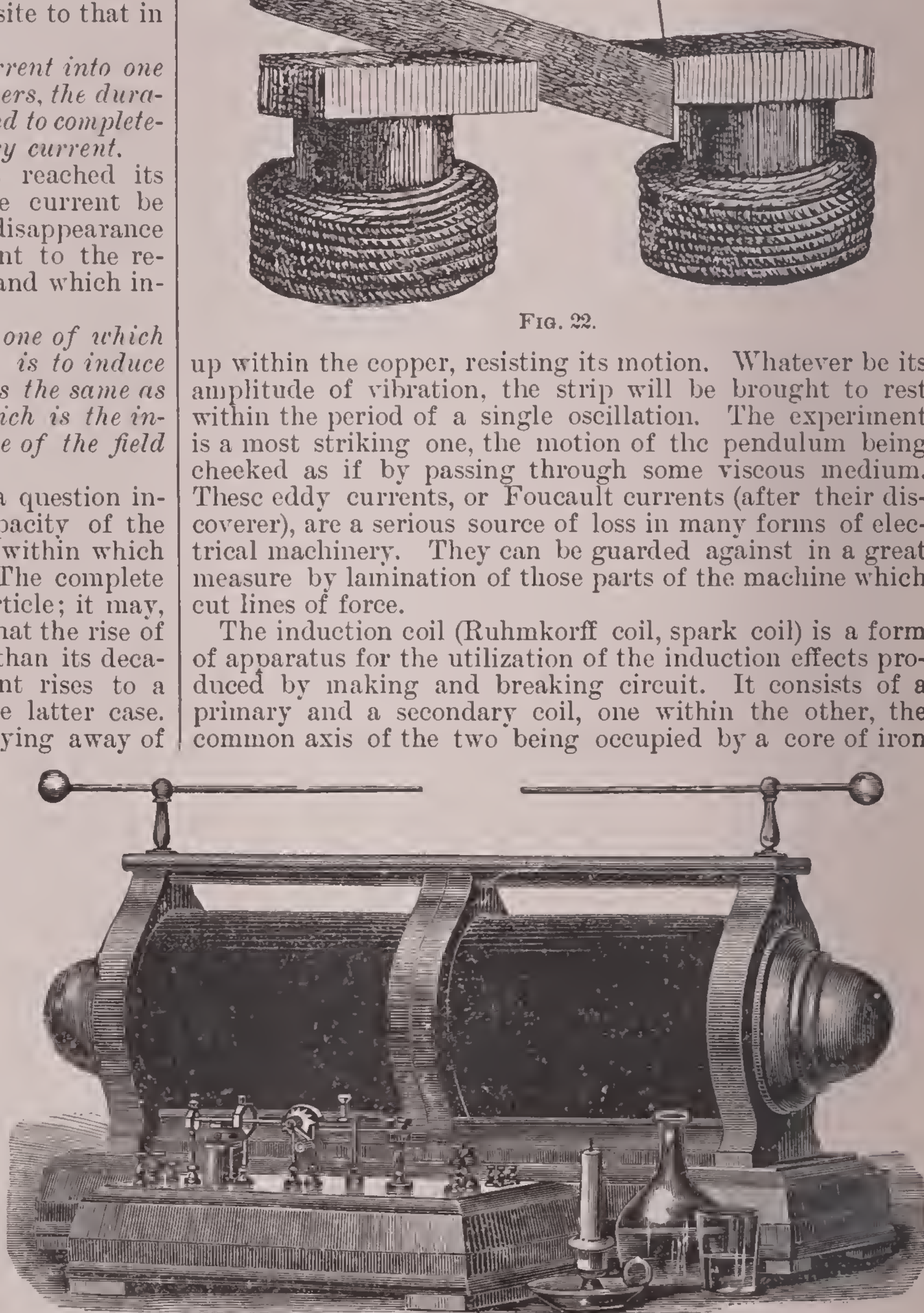


Fig. 23.

wires. Since the ordinary use to which the induction coil is put is to obtain spark discharges similar to those obtained from the Holtz machine and devices of that character, the primary usually consists of a few turns of *heavy wire*, the secondary coil of very many turns of *fine wire*. The details of construction of such coils, and some account of their performance, are given under Induction Coil (*q. v*).

The currents obtained by induction, either in the movement of conductors in the magnetic field, as in the case of the dynamo, or by making or breaking circuit, as in the Ruhmkorff coil, are identical with voltaic currents, being capable of producing electrolysis, of developing heat in accordance with Joule's law, and of magnetic action. Where the potential rises to values giving disruptive discharge, on the other hand, all the phenomena usually identified with electrification by friction or by electrostatic induction occur.

Induction currents arising from the presence of undulating or alternating currents in the primary coil have found extensive application. The telephone transmitter (see TELEPHONE), the MICROPHONE (*q. v.*), and the system of telegraphy to and from moving trains are examples in which undulatory currents, often of very intricate character, are transmitted from one coil to another by induction. The TRANSFORMER (*q. v.*; see also ALTERNATE CURRENTS) is an induction coil for the transfer of the alternate current from one circuit to another, and thence, often at greatly changed tension, to a distance. A notable illustration of its use was that of the transmission of power by means of transformers from Lauffen, on the Neckar, to Frankfort, during the Electrical Exposition of 1891.

Some of the most interesting phenomena connected with electro-magnetic induction are those which take place when the medium within which the field of force is set up is iron. These are considered under MAGNETISM OF IRON (*q. v.*).

Other phenomena, also of the utmost interest in their bearing upon our conception of the nature of electricity and its relation to other branches of physics, particularly to light and the science of radiation, are treated in the article LIGHT, THE ELECTRO-MAGNETIC THEORY OF (*q. v.*).

For further information upon the topics contained in the present article, the reader is referred to such treatises as Wiedemann, *Elektricität*; Riess, *Die Riebungselektricität*; Frölich, *Handbuch der Electricität und Magnetismus*; Larden, *Electricity*; Thomson, *Lessons in Electricity and Magnetism*; also to the standard treatises on physics.

For the mathematical theory of electricity, the works of Maxwell, Thomson, Boltzmann, Hertz, and Poincaré should be consulted.

In electrotechnics, Thomson's *Dynamo-electric Machinery*; Dredge, *Electric Illumination*; Kittler, *Handbuch der Elektrotechnik*; Fleming, *The Alternate-current Transformer*; Ewing, *Magnetism of Iron and other Metals*; also the pages of such journals as *La Lumière Électrique*, the *Electrician*, *Electrical Review*, and *Electrical Engineer*, of London; the *Electrical Engineer* and the *Electrical World*, of New York, are among the most valuable sources of information.

Finally, the transactions of the great scientific academies and technical societies afford the student of electricity means of consulting original sources, as do also the pages of the various physical journals and the reports of international electrical exhibitions. E. L. NICHOLS.

Electricity, Animal: that developed by living animals, such as the torpedo and electric eel. The shock given by a fully grown electric eel is said to be sufficiently powerful to cause death; it is certainly sufficient to knock a man down. Electric currents are claimed by some, and denied by others, to be generated in muscular and nervous tissue, and elaborate experiments have been devised to prove that the electrical action shown by muscle is not a natural attribute of the muscle itself, but due to change produced by injury to the fibers. F. A. LUCAS.

Electric Lighting: a system of artificial illumination in which the source of light is rendered incandescent by the agency of the electric current.

Historical.—Although the beginnings of electric lighting are to be found in certain lecture-room experiments of the very early years of the nineteenth century (in the case of the arc-light as early as 1802), its rise and development as an industrial element and as an important factor in civilization is a matter of the last quarter of that period. From the day when Sir Humphry Davy exhibited his electric light (a magnificent 4-inch arc fed by 2,000 cells of battery) in 1821, the splendor of this source of illumination was recognized. Faraday may have assisted in this experiment of his master, Davy, whom he was soon to succeed as director of the Royal Institution, but although he spent a long life in furthering the science of electricity, he died an old man before the electric arc had come to be a street light in London.

The practical development of electric lighting on a large scale began with the introduction of the dynamo, which machine, in turn, owed its early development almost solely to the desire for cheap and reliable means of generating current for the production of light.

There are three periods into which the history of the rise of this great industry naturally divides itself:

(*a*) From the beginning of the nineteenth century to 1867, during which the only source of current for electric lighting was the voltaic battery, and during which, consequently, the electric light was to be seen only in a few of the better equipped laboratories. (*b*) From 1867 (in which year Werner Siemens and Wheatstone announced respectively the principle of series-wound and shunt-wound self-excited dynamos, and Ladd and Wilde perfected their machines for electric light) to 1879–80. During this period the Siemens and Gramme types of dynamo were developed and perfected, and the electric arc-light began to make its appearance, although still in a tentative way, in the great cities. Toward the end of this period (1877) the Jablochkoff candle was introduced into Paris and London upon a commercial scale. (*c*) The third period, from 1879–80 onward, has been that of the general commercial introduction and development of electric lighting. It began with the perfection of the glow-lamp and the invention of the "open coil" machines of Brush and of Thomson and Houston, which, by virtue of their excellent regulation, greatly hastened the introduction of arc-lighting.

How rapid the growth of electric lighting has been may be gathered from the following statistics:

In 1877 the industrial electric lighting of the world consisted of 300 or 400 Jablochkoff candles in operation in Paris and London, with a few insignificant plants elsewhere. Ten years later there were, in the U. S. alone, 140,000 arc-lights in the "all-night" service of street-lighting, etc., and 650,000 glow-lamps (Martin, *Electrical World*, vol. ix., p. 50).

There were in thirteen principal cities of Germany in that year 3,280 arc-lamps and 50,000 glow-lamps. The same cities, however, contained 1,221,882 gas-flames; so that electric lighting still formed but 4 per cent. of the total of artificial illumination.

In the U. S. a year later there were 102,000 arc-lights and 1,700,000 glow-lamps. In 1889 225,000 and 3,000,000 respectively; and at the present time it is almost impossible to estimate the numbers.

The two great systems of electric lighting, by arc-lights and by glow-lamps, have thus grown up side by side, each without encroaching upon the domain of the other. The arc-lamp is used as a means of lighting streets and large spaces under roof, such as railway stations, markets, warehouses, and wharves. The incandescent lamp finds its proper field in detailed lighting, as in lighting the apartments of hotels and private houses, in lighting steamships and railway trains, and in nearly all "indoor illumination."

The arc-light has as its essential features (*a*) two pencils of graphitic carbon, generally placed in line with one another with common axis; (*b*) a mechanism for maintaining them in a constant position, with the tips nearly, though not quite, in contact, viz., with an air-space of from 1 to 5 mm. The pencils and the intervening air-space form part of an electric circuit through which there flows, as a rule, from 5 to 10 ampères of current, and in certain special cases much more.

The possibility of maintaining a current through such an air-space depends upon the fact that gases, although possessed of insulating power when cold, become conductors of electricity when sufficiently heated. In order to render the resisting medium, air, incandescent, the carbon points are brought into contact. A current then flows, heat is generated at the imperfect junction of the carbons, which, together with the intervening air-film, attain a high temperature. The pencils may then be withdrawn to a distance of several millimeters without extinguishing the arc.

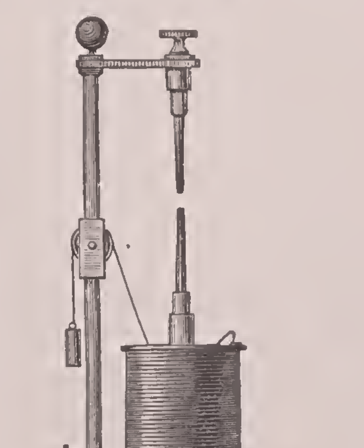


FIG. 1.—Archereau's regulator.

An arc-lamp, to be successful, must contain some device for establishing the arc in this way, and then for maintaining a proper distance between the carbons automatically. The approach of the carbons is performed either by clockwork or by the action of gravity upon the upper carbon, the lower pencil being fixed. The regulator lamps of Duboscq, Foucault, Siemens, and others belong to the former, nearly all lamps in ordinary commercial service to the latter class. As soon as contact between the carbon tips has been made the pencils are drawn apart, either by the clockwork train, driven by a spring but started and stopped electrically, or by a clutch operated directly by an electro-magnet. This play of the carbons, in which they approach each other at every diminution of the current and separate whenever the current increases again, constitutes the regulation of the lamp.

Innumerable devices for performing these operations have been resorted to, most of them based upon the principles just touched upon. One of the earliest of arc-lamps, Archereau's regulator, is shown in Fig. 1. In this lamp the lower carbon is movable, being balanced by a weight which acts over a pulley. When the current passes through the solenoid, the lower carbon-holder, which is partly of iron, is drawn down into the core of the coil until the resistance of the arc reduces the current to the extent necessary to bring about equilibrium between the magnetic forces and gravity. Figs. 2 and 3 show other early forms of the arc-lamp. They illustrate the two types

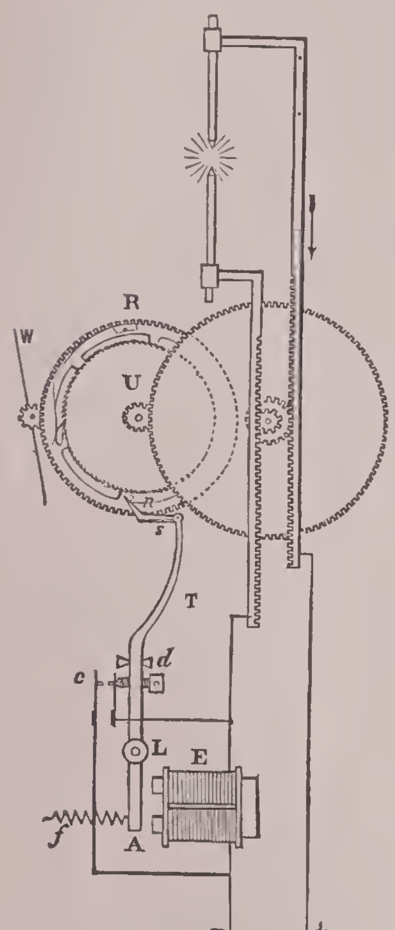


Fig. 2.—The Siemens or Häfner-Alteneck regulator.

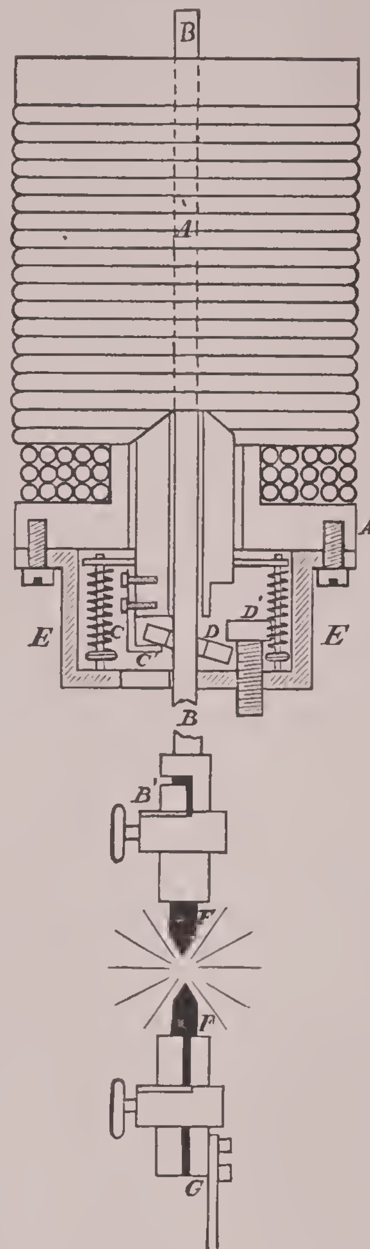


Fig. 3.—The Brush regulator (an early form).

most frequently met with in modern practice. In the Siemens regulator (Fig. 2) the electro-magnet E, which is in circuit with the arc, attracts the anchor A, moving the gang of toothed wheels in such direction as to slightly separate the carbons. By means of the contact device, *c d*, which throws the magnet out of circuit, this movement of the anchor is repeated over and over again until a balance is obtained. Fig. 3 shows one of the older forms of the Brush lamp, of which many modern commercial lamps are modifications. The lower carbon-holder is fixed. The upper one, B B, plays freely within the iron cylinder C, which in turn forms the movable core of the large solenoid A. The clutch consists of a flat brass collar, D, which surrounds the carbon-holder. When no current is flowing, C drops to the bottom of the box E E, and the ring assumes a horizontal position, releasing the carbon, which falls until contact occurs between F and F. The circuit thus completed, the core rises within the coil, D is thrown into an oblique position, clutching the carbon-rod B and lifting the pencil out of contact. The arc once established, the upper carbon is held in its proper position magnetically, every fluctuation of current being followed by a slight readjustment of its position, tending toward the maintenance of equilibrium.

In the case of an arc-lamp fed with direct current, it is found that the positive carbon is much hotter than the negative; also that it is consumed more rapidly. Roughly speaking, the rate of consumption is as two to one, but this ratio, which is by no means fixed, depends upon the voltage of the arc, the amount of current flowing, and the quality of the pencils. The shape of the two pencils is also characteristic, the upper or positive terminal being flattened or even indented, forming a "crater," while the lower carbon is pointed, and there is a tendency for the carbon particles transferred through the arc by the current to build a nipple in the axis of the pencil. These features are shown in Fig. 4.

Fig. 4.

The crater is the surface of highest incandescence in the arc-lamp. Consequently the illumination will be a maximum in those regions surrounding the lamp from which its surface is visible (viz., obliquely below the lamp and at an angle between 40° and 60° from the horizontal plane). Fig. 5 is a diagram indicating the vertical distribution of light from a direct current arc-lamp.

The length of the radius vector gives the candle-power emanating in the direction selected. The form of the curve of illumination will vary in different cases with the length of the arc, the diameter of the carbons, and the amount of energy developed in the lamp. The diagram may be regarded as typical for the case of an ordinary commercial lamp with carbons half an inch in diameter, a potential-difference of 50 volts and 10 ampères of current flowing through the lamp.

In the case of arc-lamps fed with alternating currents the conditions are altogether different from those which exist where the direct current is employed. The distribution of light above and below the horizontal plane is more nearly equal, and the difference in form of the two carbons is less marked. The illumination at any given instant is by no means uniform, but the distribution shifts so rapidly as to defy close measurement.

The candle-power of arc-lights, in general, has been greatly overrated. For example, according to the system in vogue up to 1890, and used to some extent even after that year, lamps were rated at 2,000 "nominal candle-power," the "mean spherical" illuminating power of which was from 250 to 400 candles, and whose brightness in the direction of

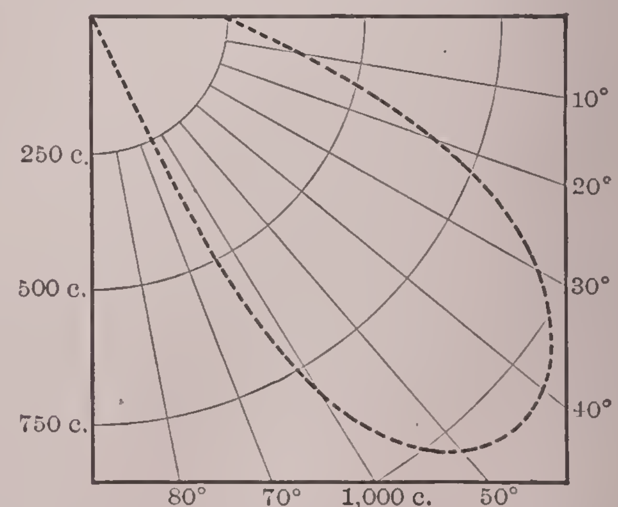


Fig. 5.—Curve of the distribution of light on one side of a direct-current arc-lamp.

the maximum was from 1,000 to 1,500 candles. Fig. 5 is taken from measurements upon such a lamp, the mean spherical candle-power of which is but 491 candles. The maximum radius of the curve, which indicates the intensity of the light in the direction of greatest brightness, corresponds to 1,056 candles.

The candle-power of the average arc-light when viewed in the direction of greatest brightness is found to be about five times the intensity in a horizontal plane. The average "mean spherical candle-power" is about 35 per cent. of the maximum.

For special purposes, such as search-light illumination at sea and the illumination of large areas from a single point, lamps of great candle-power are employed. The increased power is obtained by sending very heavy currents through large pencils. Wherever practicable, however, a better effect is obtained by the subdivision of the light into many lesser units. Many attempts have been made to state the candle-power of the arc-lamp in terms of the current flowing, or of the voltage, or of the electrical energy expended in overcoming the resistance of the arc. The factors which go to determine the brightness, however, are numerous, and some of them, such as the hardness and structure of the carbons, difficult to define and control. M. Palaz (*La Lumière Électrique*, t. 37, p. 420, 1890) finds that the intensity of arc-lamps, measured in the direction of the maximum brightness, may be expressed very nearly by means of the formula

$$I_m = 20i + 0{\cdot}4i^2,$$

where I_m is the illuminating power in carcels and i is the current in ampères. To reduce to candle-power, the result must be multiplied by 9·5 (the ratio of the British candle to the carcel).

Tischendoerfer has tabulated results of measurements of the candle-power of the arc under varying currents, as follows:

2 ampères	25 candles*	12 ampères	1,900 candles
3 "	165 "	14 "	2,425 "
4 "	300 "	16 "	3,000 "
5 "	456 "	18 "	3,625 "
6 "	625 "	20 "	4,300 "
8 "	1,000 "	40 "	13,800 "
10 "	1,425 "	50 "	20,424 "

The quality of the light from the arc-lamp is very different from that of most other sources. The hottest portion perhaps of the radiating center is the arc itself. This is simply a mass of incandescent vapor. Its spectrum is a bright-line spectrum with its energy massed in regions ly-

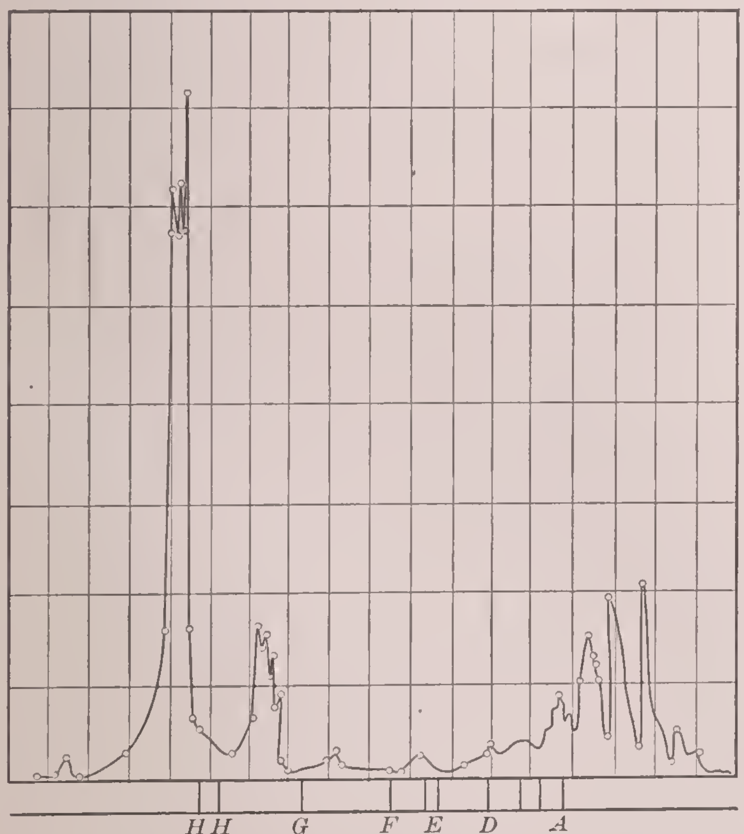


Fig. 6.

ing, for the most part, outside of the visible spectrum. Fig. 6 shows the distribution of the arc-spectrum (according to Prof. B. W. Snow, *Annalen der Physik*, 1892).

The maxima lying beyond wave-length ·8μ are of no interest from the photometric point of view, but the two crests near ·4μ are of great importance. It is to these, which represent complicated groups of violet bands, due to carbon, that the arc-light owes its characteristic bluish color, also its great power of affecting the photographic plate. The light of the arc-lamp, however, is chiefly due to the crater and to the contiguous regions on the two pencils. These afford radiating surface at all stages of incandescence down to the red heat. The radiation from all of these surface elements goes to form the "continuous spectrum" of the electric arc, which, when mingled with the rays of the bright-line spectrum, makes up the *arc-light*.

* Measured in the direction of maximum brightness.

The electric arc-light, as a source of artificial illumination, is surpassed in whiteness and brilliancy by the magnesium light alone.

To counteract the too great contrast of light and shade due to the extreme concentration of the are-light, shades of porcelain and milk-glass, etc., are frequently necessary. These give the desired diffusion, but at the expense of from 40 to 60 per cent. of the light.

Electric lighting by incandescence, while a more recent, has become a more important industry than arc-lighting. Only about 3 per cent. of the artificial illumination in cities is devoted to lighting streets and public places. Nearly all other illumination is of a kind to which the glow-lamp (better known in the U. S. as the "incandescent lamp," and to some extent in Great Britain as the "incandescence lamp") is much better adapted than is the arc-light.

Since its introduction about 1879, after a long period of experimental development in the hands of Lane-Fox, Swan, Edison, Maxim, Weston, and many other inventors, the glow-lamp has undergone minor modifications of construction, but in its essential features it consists of a filament of carbon in an exhausted bulb. The filament, in the absence of oxygen, may be brought to a white heat without combustion. Since the resistance of the form of carbon used in such lamps is high, great heat results from the passage of the voltaic current. In the absence of a surrounding medium, cooling by convection currents does not occur, and dissipation of energy takes place by radiation. Of this radiant energy a certain small proportion is light-giving.

The number of substances capable of carrying current, and refractory enough to remain in the solid form at the temperatures necessary to the production of the desirable light, is small.

The metals of the platinum group were first tried, but lamps in which they formed the incandescent material were very short-lived. The carbon filament alone has been found reasonably permanent under the conditions to which it must be subjected. Carbon has the further advantage of cheapness, and it has high radiating capacity.

The skeleton upon which lamp filaments are formed is generally a strip of fibrous material containing carbon, from which all the more volatile components have been expelled by heating to a bright cherry red under conditions which prevent oxidation. Silk and cotton threads, hairs, strips cut from the bamboo and from similar plants, using the close-grained portions lying next beneath the siliceous coating of the stem, loops stamped from paper by means of a die, and a variety of other materials have been utilized.

Of these, the skeleton in a few cases—notably that obtained from the bamboo—is suitable for light-giving purposes without further manipulation; as a rule, however, it is built up by the deposition of the silvery gray form of carbon which is derived by the decomposition of the hydrocarbons at high temperatures.

To obtain this deposit the filament is surrounded with the hydrocarbon vapor, and brought to a white heat by the application of the current. The vapor is thus decomposed, and the entire surface of the filament is covered with a layer of the residual carbon. This treatment is continued until the filament has acquired the desired cross-section and conductivity. Such filaments are technically known as "treated carbons," in contradistinction to those which have not been through this building-up process. After being thus prepared the filament is mounted in a glass bulb, and the air is exhausted by the aid of a mercurial pump (as the Geissler or the Sprengel pump, for which see PNEUMATICS). See VACUUM. Further description of the construction of the lamp is given in the article LAMPS (electric).

The quality of the light obtained from incandescent lamps is that which a carbon surface would radiate at the temperature at which the filament is maintained. Since that temperature does not differ greatly (although in general it is somewhat higher) from that of gas and petroleum lamp-flames, and since the radiating material is the same (carbon in solid form), the quality of the light of the glow-lamp is similar to that of the above-mentioned flames.

The light of the glow-lamp, however, is due to a carbon surface all at one temperature, which temperature varies with the electrical energy expended in the lamp, while that of gas and petroleum flames is made up of radiation from a great number of separate carbon particles, the temperature of which depends upon their position within the flame. The mean temperature of the flame, on the other hand, is always nearly constant.

In spite of this slight difference of condition, it is possible to find a temperature at which an incandescent lamp will give light, the distribution of energy of which throughout the visible spectrum will agree approximately with that of an ordinary naked "bat's-wing" gas flame. Five lamps tested for the purpose in 1891 (Mr. J. C. Shedd observer) were found to reach the condition of incandescence most nearly corresponding to that of the gas flame (at 15·1 candle-power), the energy expended then being 4·3 watts per candle (average). This was at a somewhat lower temperature than that at which the lamps were intended to be used, viz., 16 candles.

At lower temperatures than the above the light of the glow-lamp differs from that of gas in being relatively richer in the red, and at still higher temperatures in being richer in the blue.

Distribution of light from the glow-lamp is a question of the cross-section of the filament. Filaments of circular

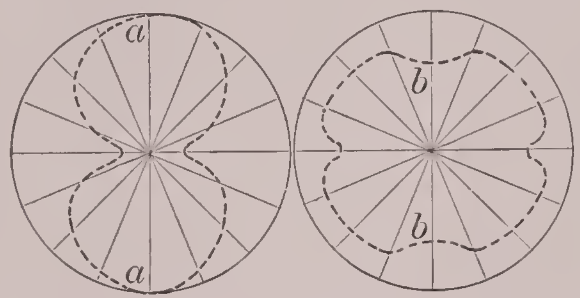


Fig. 7.—Diagram showing the distribution of light in the case of glow-lamps with filaments of rectangular cross-section.

cross-section give almost uniform distribution in the horizontal plane. Filaments are, as a rule, rectangular in cross-section. These are placed with the longest diameter in the plane of the filament, or at right angles to that plane. The result is that different amounts of radiating surface are exposed, according to the direction from which the lamp is viewed. Curves a and b, Fig. 7, show the results of candle-power measurements upon lamps of these two types.

The electric maintenance of arc and incandescent lamps is carried out upon entirely distinct systems. Arc-lamps are placed in series (Fig. 8), the same current traversing all that are in circuit. Glow-lamps are arranged in multiple (Fig. 9). The condition to be met in dynamo machines for arc-lighting is complete and automatic regulation for constant current through wide ranges of external resistance. The dynamo for incandescent lighting, on the other hand, must possess complete power of regulation for con-

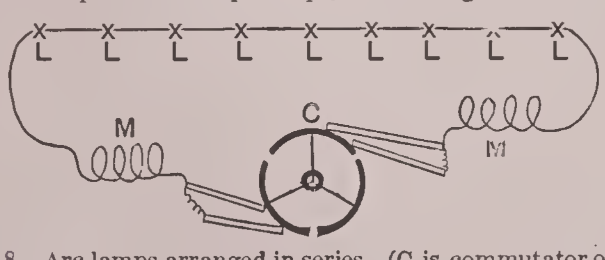


Fig. 8.—Arc-lamps arranged in series. (C is commutator of dynamo; M, M, the field magnets; L, L . . ., the lamps.)

stant potential. The means by which these requirements are met is described in the article Dynamo-electric Machine (*q. v.*). The desirability of furnishing both arc and glow lamps from the same circuit has led to many attempts to operate arc-lamps on constant-potential circuits and incandescent lamps in series. It has been found possible to do both, but the conditions are such as to lead to a separation of the two types wherever practicable.

In arc-lighting the number of lamps which can be fed by a single machine is limited to about sixty. The difference of potential at the terminals of the dynamo, about fifty volts for each lamp in circuit, reaches a value at this limit, beyond which it is not found possible to maintain the insulation of the machine. In incandescent lighting the number of lamps which can be supplied from a given center is limited only by the cost of the copper conductors necessary to carry the current. Since the potential-difference is independent of the number of lamps, the amount of current must increase in direct proportion to that number, and with it the weight of copper used.

Thus far this article has dealt with electric lights maintained on direct-current circuit. It is equally practicable,

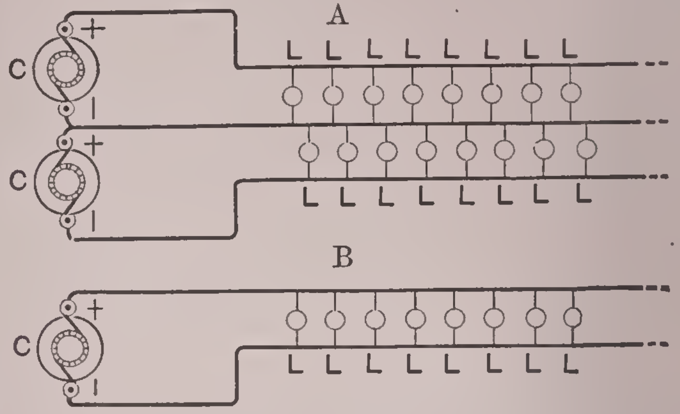


Fig. 9.—Arrangement of glow-lamps in multiple: A. three-wire system; B, two-wire system. (C, C, C, commutator of dynamo; L, L . . ., lamps.)

and under many circumstances more advantageous, to use alternating currents.

In the earliest days of arc-lighting alternate-current generators were employed, and the delicacy of regulation possible in alternate-current dynamos, without loss of efficiency, has led to a return to the older practice. For incandescent lighting also, wherever it is necessary to transmit to considerable distances, the alternate current permits the carrying of large amounts of energy over small wires. This is accomplished by the use of the Transformer (*q. v.*; see also Alternate Currents and Dynamo-electric Machine), a device by means of which the current and voltage in a circuit may be raised and lowered almost at will, their product which

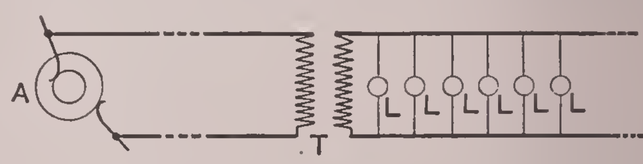


Fig. 10.—The arrangement of glow-lamps in an alternating-current circuit: A is the armature of the alternator; T is the transformer; L, L, L . . ., arc-lamps.

represents the energy remaining constant. Fig. 10 shows the arrangement of a circuit for transmission of energy to glow-lamps at a distance by means of an alternate-current generator and transformers.

The economy of the electric light is a question involving many factors. One does not have to deal, as in light production by direct combustion, simply with the consumption of fuel by oxidation. In the arc-lamp, nevertheless, the carbon pencils undergo continual disintegration, and have to be renewed daily at an appreciable cost. Even the glow-lamp, although incandescence takes place in the absence of oxygen, is subject to more or less rapid depreciation during service, and the renewal of degenerated lamps is an item of expense to the consumer. The life of the incandescent lamp diminishes as the temperature at which it is maintained rises. The amount of light per unit of energy expended, on the other hand, increases very rapidly with the temperature. The relationship between life and the degree of incandescence has been carefully studied by John W. Howell (*Transactions Am. Institute of Elec. Engineers*, vol. v., p. 239). The curve in Fig. 11 gives graphically the results which he has obtained from the life study of a very large number of lamps.

Abscissas in this diagram represent the degrees of incandescence (indirectly the temperature of the filament), expressed in terms of the number of watts expended in the lamps to produce a candle-power of light. Now, the cost of light to the consumer is made up of two factors—viz., the cost of developing the necessary amount of energy in the lamps, and that of renewing the broken lamps upon his circuit. He may, for instance, pay 50 cents apiece for lamps, and 3, 5, 10. or even 20 cents per kilowatt (one horse-power is equal to 0·7459 kilowatts) per hour; or the price of lamps may be 20, 30, or 40 cents, with power at any one of the above rates. Whatever may be the relative cost of power and of lamp renewal, the sum of these two factors can be so proportioned as to always be at a minimum. Mr. Howell has investigated this relationship, and found that the minimum total cost always occurs when lamp renewals make up 15 per cent. of the total cost of operation. It is interesting and important to note the way in which the efficiency of glow-lamps rises with the degree of incandescence. If such a lamp is taken and brought successively to 5, 10, 15, 20, etc., candles, and in each case the energy expended within the lamp is noted, it is found that as the candle-power rises the energy necessary to produce one candle-power of light falls off. If the results thus obtained are plotted graphically a curve similar to that shown in Fig. 12 is always obtained, by inspection of which it is found that a lamp requiring 15 watts per candle, in order to produce 2 candle-power of light, required but 3 watts per candle when the intensity was increased to 21 candles.

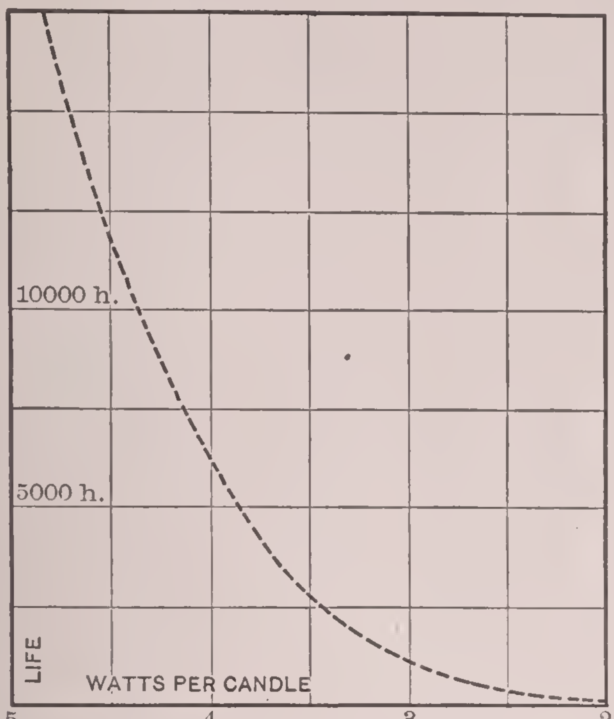


FIG. 11.—Curve showing lives of equally good lamps burned at different efficiencies (Howell).

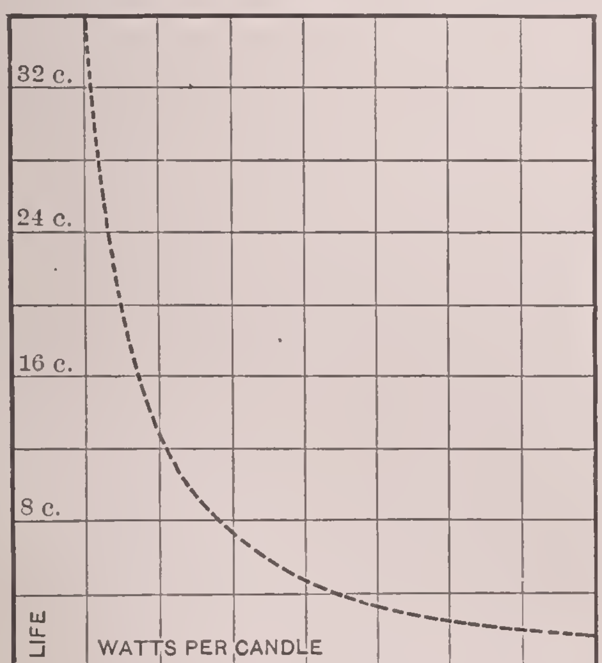


FIG. 12.—Curve showing the relation between candle-power and efficiency in the glow-lamp.

The discussion of the economy of the electric light involves more than the question of the electrical energy expended within the lamp and the amount of light produced. To define the performance of arc and glow lamps, considered as machines for illumination, the total amount of work done must be taken into account and its relation to the available light-giving radiation expressed in units of energy. In the case of light produced by direct combustion of fuel, as in the candle and oil flames, the problem reduces itself to a consideration of the total energy of combustion and the mechanical equivalent of luminous radiation.

Estimates of the energy dissipated in various sources of light have frequently been made. F. Fischer (*Bericht über die Electrische Ausstellung in Wien*, 1883, p. 461) found the following results with the usual older forms of illuminant:

TABLE SHOWING PRODUCTS OF COMBUSTION AND THE AMOUNTS OF HEAT DEVELOPED IN THE PRODUCTION OF 100 CANDLE-POWER OF LIGHT (FOR ONE HOUR).

ILLUMINANTS.	H_2O (Kg.).	CO_2 (cubic meters).	Heat (greater calories).
Gas (argand burner)	0·86	0·46	4,860
Gas (fishtail burner)	2·14	1·14	12,150
Petroleum (round wick)	0·37	0·44	3,360
Petroleum (flat wick)	0·80	0·95	7,200
Rapeseed oil (carcel lamp)	0·52	0·61	4,200
Rapeseed oil (student lamp)	0·85	1·00	6,800
Wax candle	0·88	1·18	7,960
Stearin candle	1·04	1·30	8,940
Tallow candle	1·05	1·45	9,700

In comparison with these values the heat emitted by the arc and glow lamps is insignificant.

A glow-lamp maintained at 3·1 watts per candle generates 266 calories per hour per 100 candle-power of light. An arc-lamp under good conditions emits only 86 calories of heat per hour for each 100 candles (mean spherical), or 29 calories for each 100 candles, measured in the direction of maximum illumination.

The heating effect of electric lights, as compared with wax candles, is therefore about 3 per cent. for glow-lamps and less than 1 per cent. for arc-lamps, with the additional advantage of freedom from the products of combustion.

A comparison of glow-lamps and gas, made in the Royal theater in Munich (see v. Pettenhofer, *Bericht über die Elektrische Ausstellung in Wien*, 1883, p. 463), showed that in the empty auditorium gas raised the temperature of the air in the upper gallery about 16·5° F., glow-lamps about 1·5° (9·2° C. and 0·83° C.). Even when the theater was occupied the difference was as much as 11° F. (6° C.).

With gas the amount of carbonic acid gas in the gallery, with the auditorium empty, rose in one hour from ·0004 to ·0020.

The amount of heat generated in electric lamps and in various flames affords no measure of the relative efficiencies of the systems of illumination. When fuel is burned to produce light the total expenditure, excluding such extraneous items as the cost of conveying the combustible to the point of consumption and the expense of refining and preparing fuels (as oils and gas) from cruder forms, is represented in the energy of combustion of the flame. In the case of the electric light the losses in boiler-room, in the steam-engine and dynamos, and the loss in electrical transmission from the generator to the lamp, must be added to the heat losses in the lamp itself.

Study of the character of the rays emitted by artificial illuminants shows that gas flames, etc., radiate between 98 and 99 per cent. of waves too long to be of service in lighting; also that the glow-lamp sends out 95 per cent. of such rays and the arc-lamp 90 per cent. The radiant efficiencies of these sources are then 1 per cent. to 2 per cent., 5 per cent. and 10 per cent. respectively.

Of the heat of combustion of flames, on the one hand, about 15 per cent. to 20 per cent. is dissipated by radiation, so that the total efficiency of these sources can not be greater than ·003. Of the total energy represented in the coal used to produce electric lights, on the other hand, not more than 10 per cent. reaches the lamp; so that the *maximum total efficiency* of these may be placed at ·005 and ·010 respectively. In the case of many installations for electric lighting, where the conditions of highest economy of transformation have not been observed, much lower values for the total economy would be found.

Direct determinations of the energy of the rays which go to make up a candle-power of light afford an excellent means of checking the above-mentioned estimates. It is found, for example, that a candle-power represents about ·216 calories per hour. Applying this value to the case of a wax candle, in which energy is dissipated (according to Fischer) at the rate of 79·6 calories per hour, the total efficiency of this source is

$$\frac{\text{light-giving energy}}{\text{total energy}} = \frac{\cdot 216}{79\cdot 6} = \cdot 0027,$$

a value in good agreement with that obtained by the former method.

Regarded as a light-making device, the efficiency of the arc and glow lamps is not very much higher than that of the sources of artificial light which they have in a great measure superseded.

The question of actual relative cost of production is a most complicated one, involving the cost of power, of attendance, of interest upon the money invested, as well as the price of copper and of machinery. The adoption of electric lights is more frequently based upon other considerations than upon mere cheapness of production. Sanitary or æsthetic conditions often prevail, or the adaptability of the light to the circumstances under which it is to be used. The applications of the electric light are almost innumerable. In some cases, it is true, where much was expected, unforeseen difficulties have led to the return to the older illuminants. This is the case in *coast lighting*, for which purpose the brilliancy of the arc-light seemed to indicate it as the most desirable of sources. The experiments of Tyndall in the service of the Trinity House, 1876–77, showed, however, that in thick weather the shorter wave-lengths of the spectrum, which are especially prominent in the arc-light, are wholly absorbed by the atmosphere; so that the fluctuations both in quantity and quality, with changes of weather, rendered the electric arc the very worst of lights for lighthouse purposes. In many other situations, as in lighting mines, steamships at sea, in submarine work, etc., the electric light possesses advantages such that the question of cost becomes unimportant. In these and in innumerable other services where it is not in the same sense indispensable, it has come to be regarded as an essential feature of modern equipment. Many details concerning the electric light may be found in the following special treatises:

Dredge, *Electric Illumination*; Maier, *Arc and Glow Lamps*; Hedges, *Continental Electric-light Stations*; Desmond, *Electricity for Engineers*; also in the admirable summaries published from time to time by MM. Palaz, Richard, and others in *La Lumière Électrique* (Paris); also in the reports of the commissions of the electrical exhibitions of Philadelphia, Paris, Munich, Vienna, Antwerp, Frankfort, etc. E. L. NICHOLS.

Electric Meters: appliances for the measurement of the energy developed in an electric circuit. These are of three kinds: (*a*) clockwork recorders, (*b*) chemical meters, (*c*) motor-meters. In the first a known fraction of the current to be measured passes through a galvanometer which records by means of a stylus upon a chronograph sheet driven by clockwork. Large first cost and the difficulties of maintaining clockwork devices in continued use have kept this class of meters out of general use. Chemical meters are zinc voltameters, the plates of which are weighed from time to time. Motor-meters are electric motors, the speed of which is recorded by a dial device like that of the gas-meter. See METERS and WATTMETERS. E. L. N.

Electric Motor: a machine for the conversion of electrical energy into the form of mechanical power. The first motor of any real importance was constructed by Jacobi in 1838. This motor, like all its predecessors, depended for its action on the attraction and repulsion of electro-magnets. Its efficiency was very low, chiefly because of the large amounts of energy that had to be expended in producing magnetization in magnetic circuits, completed only through large air-gaps. The iron masses or electro-magnets, which are set in motion by the action on them of stationary electro-magnets, are called armatures. A great advance was made by the invention of the Siemens shuttle armature in 1855. This machine is the highest development of the old ideas of the electric motor—the repulsion and attraction of electro-

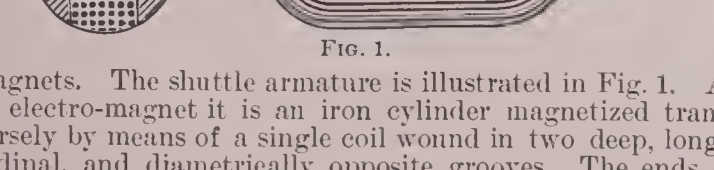


FIG. 1.

magnets. The shuttle armature is illustrated in Fig. 1. As an electro-magnet it is an iron cylinder magnetized transversely by means of a single coil wound in two deep, longitudinal, and diametrically opposite grooves. The ends of the coil are connected to opposite halves of a metallic ring, insulated and mounted on the shaft, forming a two-part commutator. Electric connection through the armature coil is made by means of brushes resting on the commutator, as shown in Fig. 2. Fig. 2 shows the form of the stationary magnet and the arrangement of the armature with respect to it. The poles present the surface of a cylinder in diameter slightly larger than that of the armature. It is seen that the function of the two-part commutator is to reverse the current in the armature at the proper instant for continuing the rotation through the action of electro-magnetic repulsion or attraction. By the adoption of this form of moving and stationary electro-magnets the magnetic effects were enormously increased, owing to the fact that the magnetic circuit is made up almost entirely of iron. The electro-dynamic effects and the efficiency of the electric motor were increased in proportion. Owing to numerous causes, the efficiency and output for a given size of machine were, however, still hopelessly low.

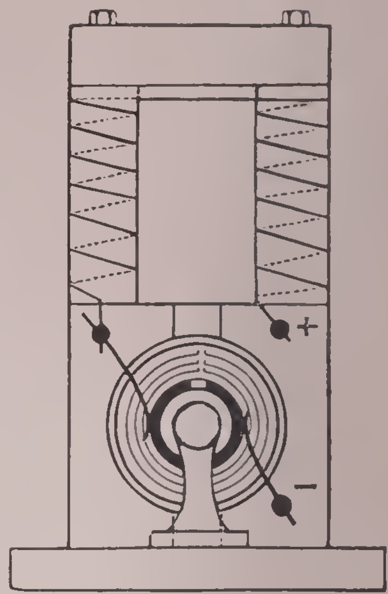


FIG. 2.

Chief among these causes were the Foucault current losses in the core and the energy wasted, and the trouble encountered in reversing the current suddenly through the large number of turns in the armature coil.

The great and effective advance of the electric motor was made shortly after the introduction of the Gramme dynamos in 1871. It was found that these dynamos would work equally well as motors, and with this discovery came a clearer understanding of the nature of electro-magnetic induction, which may be briefly stated as follows:

A conductor carrying a current and moving across the lines of force in a magnetic field takes up or gives out mechanical energy in amount equal to the product of the current through the conductor into the electromotive force developed in it by its motion through the magnetic field. The mechanical energy is given up to the conductor when the electromotive force generated in it is positive with respect to the current, and is given up by it when the electromotive force is negative. It is this knowledge that has enabled an improvement in electric motors to be made each time that an improvement has been made in electric generators. It follows from the absolute reversibility of the electro-magnetic induction of electric currents that good electric generators make good electric motors. It does not necessarily follow, however, that a good dynamo operated under one set of conditions will make an equally good motor when operated relatively under entirely different conditions.

Electric machinery for motor practice is required to operate almost universally under different conditions from that of the generator as to speed, load, and speed regulation. Where it is required to meet conditions different from those that are met by the dynamo, it must be different in design and construction. These special requirements have enlisted the attention of some of the ablest engineers of the world since the introduction of the dynamos with the Gramme and Häfner-Alteneck armatures.

The great use of the electric motor is for the transmission and distribution of power. The electric motor and the ease with which electric energy may be transmitted without serious loss to great distances make possible the commercial use of many waste powers. Served with current from neighboring electric-light stations, it is a ready and economical power in small and large units in cities. The application of the electric motor to railway propulsion forms now a great industry by itself.

There are two great classes of electric motors, direct current and alternate current. The simple law that a dynamo acts as a motor when a current from an external source is passed through its armature in a sign opposite to the electromotive force it develops extends to direct current, alternate current, and all forms of motor alike. In any motor, as in the dynamo, there are two distinct organizations of parts, the field and the armature. The field is generally established by current from the source supplying the motor. The current is allowed to pass through the armature, which sets up a rotation due to the force exerted by the action of the field on the armature. Now the motion of the armature conductors through the field produces in them an electromotive force precisely the same as though they were driven by mechanical means instead of by electro-magnetic. The electromotive force is negative with respect to the current in the armature, and is therefore called counterelectromotive force. The product of the counterelectromotive force into the current in the armature is the number of watts transformed into mechanical power. In the actual motor not all of the power thus developed is given off at the pulley of the motor; a small portion of it is expended in friction of the journals, brushes, and in losses in the armature core. Since there are two great methods for distributing electrical energy, one by constant difference of potential and variable current and the other by constant current and variable difference of potential, there are likewise two classes of motors for transforming these two great forms of electrical energy into mechanical energy. In direct-current working series motors are used exclusively on constant-current circuits, and on constant-pressure circuits both shunt and series motors are used; where constant speed is desired, as is generally the case in stationary work, the shunt motor is employed, and for speeds varying through wide ranges the series motor has been found to give the best results. A shunt motor operated as indicated in the diagram of Fig. 3 has its field excited at all times with a constant number of ampère-turns. This is so because the terminals of the field coils, whose resistance is constant, are connected to the supply main on which is maintained a constant pressure. In starting up such a motor the field is first connected to the supply mains, and then the armature through a variable resistance. The armature, on the admission of a current through it in the presence of the strong field already produced, experiences a powerful torque or tendency to rotate. As it comes up to speed the resistance is gradually cut out, and when all is cut out the armature attains the full normal speed for which it has been designed. This speed is that at which the armature produces an electromotive force almost equal and opposite to that of the supply mains; it is plain that if the armature should go fast enough to develop an electromotive force equal and opposite to that of the mains, the difference of electromotive forces would be zero, and there would be no electromotive force remaining to set up a current through the armature, which therefore would slow down slightly to a point at which this difference would be great enough to set up a current that would maintain the rotation of the armature. Since the resistance of the armature is small, the amount that it needs to slow down in order to permit even a very large current to be set up through it is but slight, generally not more than from 2 to 5 per cent. When very close speed regulation is desired, shunt-machines are given a differential winding. A few heavy turns of wire are placed on the field, and through these the armature current passes in such a direction as to exert magnetomotive force in an opposite direction to the shunt or fine wire winding. These turns are so adjusted in number that by the action of the armature current through them they weaken the field of the motor. As a consequence, the armature must run at the same speed that it did at no load in order to produce an electromotive force that is a small amount less than that of the line. This amount is equal to the fall of potential through the armature caused by the current. These principles are expressed more exactly by the aid of the following symbols and formulæ:

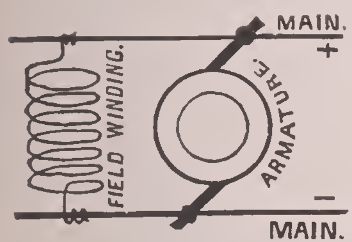


Fig. 3.

Let E be the electromotive force of the mains,
Let E be the counterelectromotive force of the motor,
Let e be the fall of potential caused by the current through the armature, or the electromotive force that sets up the current through the armature,
Let C be the current through the armature,
Let c be the current through the field,
Let R be the resistance of the armature,
Let n be the revolutions per minute of the motor armature at no load,

Whence $\mathrm{E} = E + \mathrm{e}$, $\mathrm{e} = \mathrm{CR}$, $\mathrm{C} = \dfrac{\mathrm{E}-E}{\mathrm{R}}$, $\dfrac{E\mathrm{n}}{\mathrm{E}}$ = revolutions per minute at full load,

$$\frac{\mathrm{n} - \frac{E\mathrm{n}}{\mathrm{E}}}{\mathrm{n}} = \text{per cent. variation of speed}, = \frac{\mathrm{E} - E}{\mathrm{E}} = \frac{\mathrm{e}}{\mathrm{E}}.$$

Whence the ratio of the fall of potential produced by the current through the armature to the pressure of the supply mains is the drop of the speed in a shunt motor. For example, a 10 H.-P. motor runs at a speed of 1,000 revolutions per minute on a 110-volt circuit. The current that will produce 10 electrical H.-P. at 110 volts is

$$\frac{10 \times 746}{110} = 68 \text{ ampères.}$$

The resistance of the armature, $\mathrm{R} = {\cdot}068$ ohms,

$$\mathrm{CR} = 68 \times {\cdot}068 = 4{\cdot}6 \text{ volts} = \mathrm{e}$$

$\dfrac{\mathrm{e}}{\mathrm{E}} = \dfrac{4{\cdot}6}{110} = {\cdot}042$, or 4·2 per cent. change of speed in going from no load to full load. In practice plain shunt-machines operated as motors give even better regulation than indicated by these theoretical considerations. This is due to the fact that the magnetizing effect of the current in the armature conductors is to increase the reluctance of the magnetic circuit of the field, thereby diminishing the magnetization through the armature slightly as the current in the armature comes up to its full value. The effect of this diminution of magnetization is to aid in diminishing the counterelectromotive force, so that to produce the required $\mathrm{E} - E$ to let the necessary current through the armature at full load the speed of the armature needs to fall off less than it would if these armature reactions were absent. It is not an uncommon thing, therefore, to find a shunt motor that gives a constant speed at all loads.

Series motors operated from constant-pressure circuits are usually regulated by hand. These motors are used where a great effort to produce rotation or torque is required, and where the speed must be varied by the operator at will. This is accomplished by inserting a variable resistance in series with the field winding and the armature of the motor on starting up. The most powerful fields are used, and the armature contains as many conductors as possible. Thus at low speeds the torque or starting effort is made a maximum. For higher speeds the resistance in circuit with the motor is all cut out, and for the highest speeds the field is weakened by cutting out some of the field turns, thus weakening the field, and making the motor run at a higher speed in order to maintain the counterelectromotive force. Power is often transmitted by means of constant-current generators, circuits, and motors. This system is confined entirely to stationary work. Since the current in this system, through the motor, is constant, the counterelectromotive force of the motor must vary with the load. This variation of counterelectromotive force in the motor is accomplished practically by two methods, precisely the same as in constant-current generators, viz., by shifting the brushes and by changing the magnetization through the armature by varying a resistance connected in parallel with the field. Either one of these operations is accomplished automatically by means of ball-governors attached rigidly to the motor-shaft, which act much as the automatic governors on modern high-speed engines.

Any alternate-current dynamo will operate as a motor from an alternate-current circuit that possesses the same periodicity. The alternator to be operated as a dynamo must first have its field excited by means of a direct current, and the speed of the armature brought up to its normal value, so that it will produce an electromotive force almost equal and opposite to that of the supply mains; the periodicity must also be the same, when the machine may be connected to the circuit and will operate as a motor. Alternators thus operated are called synchronous motors. The difficulty of starting them limits their use. They are used in the U. S. for transmitting water-power to distances as great as 10 miles or more, for operating stamp-mills, etc., in mining districts. Tesla, Dobrowolski, and others have devised special systems for the generation of alternate-current energy in such a form as to enable the practical operation of alternate-current motors that should be self-starting. The current used in these systems is known as the "Drehstrom," or "current that produces rotation." By means of this method during the summer of 1890 100 H.-P., developed by waterfall at Lauffen, Germany, was transmitted to Frankfort, a distance of 100 miles, with a total loss of power of but 25 per cent. At Lauffen an Drehstrom generator produced the necessary current at a moderate electromotive force, which was then transformed to a small current at 20,000 volts. At this enormous pressure the energy of 100 H.-P. could be transmitted the distance of 100 miles with a copper wire a quarter of an inch in diameter, and at a loss of but 5 per cent. At Frankfort a "step-down" transformation took place through transformers similar to those used at Lauffen; from these the current, once more at ordinary voltage and correspondingly increased strength, was delivered to an Orehstrom motor that developed 75 H.-P. in return for the 100 H.-P. given up to the dynamo by the turbines at Lauffen. HARRIS J. RYAN.

Electric Railways: those railways on which electricity is the motive power. The first step toward the application of the electric motor to railway propulsion was made by Thomas Davenport, of Brandon, Vt. He constructed in 1835 a model electric car operated on a circular track. The car motor was of the pole-attracting type, and was operated by means of batteries carried on the car. In Apr., 1851, Prof. Page, of the Smithsonian Institution, operated a 16-H.-P. locomotive that derived electric current from 100 large Grove cells carried with it. This locomotive attained a speed of 19 miles an hour, and was run on the Baltimore and Washington Railway. The motor was likewise of the pole-attracting type. The experiments of Page demonstrated the entire possibility of railway propulsion by means of electricity, but with primary batteries the cost was prohibitive. The next decided advance came with the commercial introduction of the Gramme and Siemens dynamos, which provided at once an economical means for the production of electrical energy and an efficient motor when the operation of these dynamos was reversed. From 1872 to 1887 experiments were made in Europe and in the U. S. with varying success. Among the promoters of these enterprises were Fontain and Breget, Siemens and Halske, Gramme and Egger, of Europe, and George F. Green, Edison, Stephen D. Field, J. C. Henry, Daft, Van Depole, Short, and Sprague, of the U. S. Through the efforts of these men a dozen or more experimental roads were operated, and while they were not all successful, each one constituted a great practical lesson.

Numerous forms and methods of mounting the motor were tried. Methods of every kind were used for generating and conducting the current to the motors. The direct supply of electrical energy in the form of constant current or constant potential from the generators to the motors was made by sliding or rolling contact through the rails insulated from each other and from the earth; through a third rail insulated and mounted at the center of the track in a slotted conduit, or just above the ground, using the track as a return; or through a conductor mounted on insulated supports overhead, with the track and the earth as a return for the current. Storage batteries were used by charging them at the generating stations, and then loading them on the cars to supply the motors with current, thus avoiding the need of running conductors along the road.

Out of all these practical trials, attempts, and experiments there was developed the system of electric street-railway propulsion that is now being used in most of the cities in the U. S., and has been introduced in Europe. In 1887 Frank J. Sprague undertook to equip the Union Passenger Railway, of Richmond, Va., operating twenty cars, for electric traction. The work was completed and the road went into operation with electric motive-power early in 1888. This, therefore, was the first road to be equipped in a real engineering spirit and determination: consequently the results of all previous attempts and experiments were care-

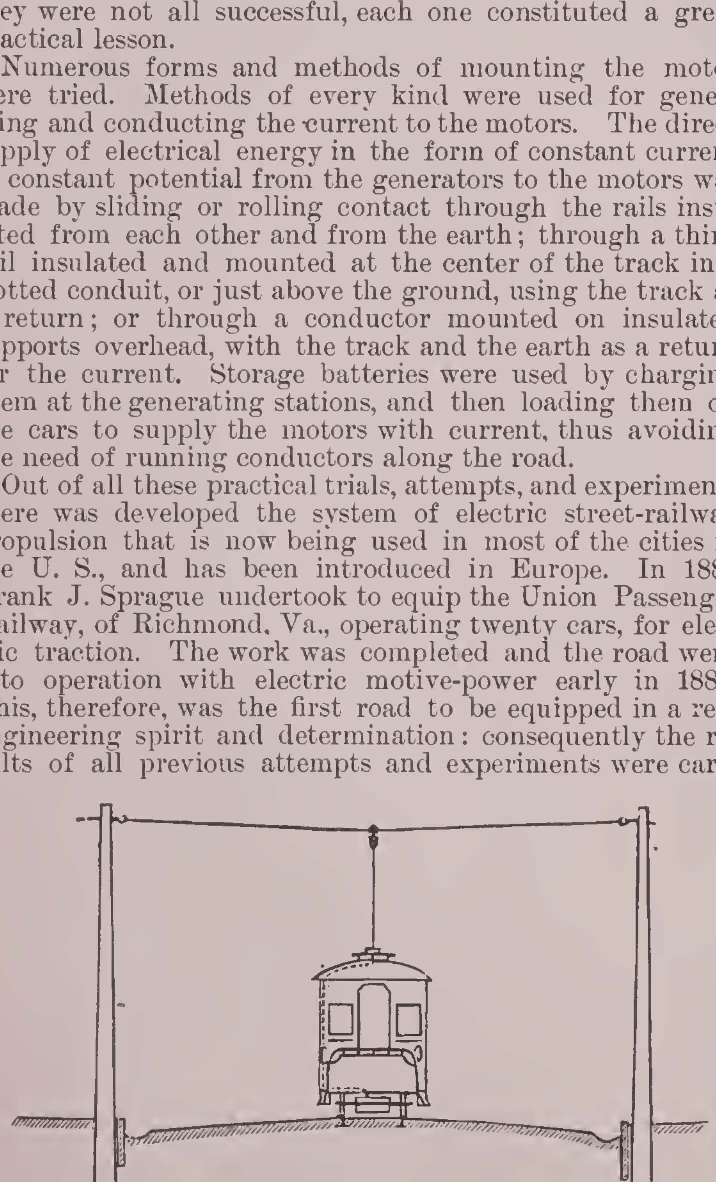


FIG. 1.

fully looked into, and the methods that were found to be best and most practicable were adopted. The final outcome was the adoption of the single overhead trolley system, using the earth and the rails as a return. The success of the Richmond road invited public confidence to such an extent that a lapse of five years sufficed to bring about the almost universal use of electric propulsion for street railways.

In modern practice the current is supplied at a constant potential of 500 volts from the dynamos in the generating station to the car motors direct by means of a bare copper wire, called the trolley-wire, suspended in the air over the center of each car-track. Fig. 1 gives one a good idea of the manner in which the trolley-wire is suspended in the streets and the method adopted for taking the current from it to the motors on the car-trucks, from which it is returned to the power-house through the wheels, track, and earth. The trolley-wire is suspended by means of cross wires attached to poles erected at the curbs in the streets. These cross wires are insulated from the trolley-wire except where it is electrically joined to the feed-wires. The feed-wires provide all extra conducting capacity needed for keeping up the full supply of current in all parts of the trolley-line. They are given a weather-proof insulation and mounted on glass insulators carried on the poles, or they are given a su-

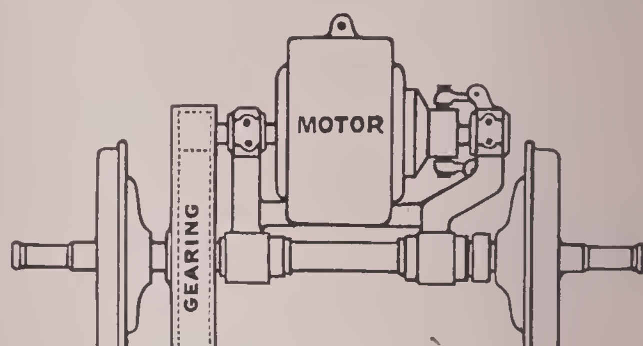


FIG. 2.

perior insulation, covered with lead, and placed in conduits underground; to these the trolley-line is joined electrically at intervals. The current is taken from the trolley-line to the moving car through the trolley and trolley-pole that are carried by the car. The trolley-pole has a pivot attachment to the top of the car, and by means of springs presses the trolley uniformly against the trolley-wire. The trolley and pole being metallic, the current is led through them to the top of the car, and thence through metallic conductors to the motors below. It is necessary, on account of its weight, to give the motor flexible suspension on the car-trucks, in order to lessen the wear on the tracks and the tendency to damage the insulation of the wires on the fields and armatures of the motors, due to the excessive shocks that would otherwise be experienced. This is accomplished by pivoting one end of the motor to the car-axle, and suspending the other with springs from the truck-frame. The power of the motor is transmitted from the armature to the axle by means of spur-gearing usually boxed in and flooded with solid oil. The method of mounting and connecting the

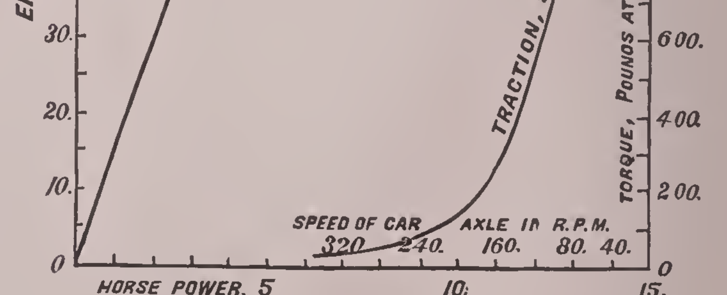


FIG. 3.

motor is illustrated in Fig. 2. Series motors are used, and for driving a 16-foot car in ordinary practice two 15 H.-P. motors, one on each axle, are used. The speed of the motors is regulated by changing the electrical pressure applied at the brushes of the armature, and by varying the magnetization through the armature. The change of electrical pressure through the armature is accomplished by means of a variable resistance in series with the motor, while the magnetization through the armature is varied by cutting in or out of circuit turns in the field winding. In some motors the two operations are made simultaneous by so winding the field coils that they will properly furnish the necessary resistance in the field circuit. Fig. 3 gives a diagram showing the relation between the efficiency and H.-P. and the speed and H.-P. for a 500-volt 15-H.-P. motor connected to the car with a single set of gears.

A prominent engineer gives the following data for good electric street-railway practice:

"There should be installed in generating capacity for power-plant 20 to 25 H.-P. per car operated, which will give reserve power.

"The cost of generating power is from three to five cents per car mile.

"A car uses, under average conditions, 1 H.-P. per car mile per hour. That is, a car operating at a speed of 5 miles, 5 H.-P.; at 8 miles, 8 H.-P.

"Cars are generally equipped with two 15-H.-P. motors.

"The attainable speed with electric motors is limited only by conditions of roadbed and local requirements; 130 miles an hour have been attained experimentally.

"Electric traction means rapid transit and increase of traffic of from 40 to 200 per cent., and moderate reduction in operating expenses per car mile."

As yet there has been no commercial application of the electric motor in which the locomotive on the overland railways of the U. S. has been displaced. Experiments, however, have been made in which higher speeds have been attained than will probably ever be made with the steam locomotive, so that it is highly probable that the highest railway speeds in the future will be obtained commercially by means of the electric motor.

In conclusion, the following facts are of interest in connection with the development of electric railways: "By Jan. 1, 1888, there were in operation in the U. S. and in Canada 13 electric roads, operating 95 motor-cars over 48 miles of track." (*The Electric Railway*, p. 350, by Crosby and Bell.) In 1892 there were "in operation or under contract more than 450 roads, equipped with nearly 6,000 cars and over 10,000 motors, and with over 3,000 miles of track. There is made a daily mileage of not less than 700,000 miles, over a billion of passengers are carried annually, and at least $75,000,000 have been invested in this industry." (F. J. Sprague's *Inaugural Address, Proceedings of the American Institute of Electrical Engineers*, 1892, vol. ix., p. 230).
HARRIS J. RYAN.

Electric Telegraph: See TELEGRAPH.

Electric Welding: a process of welding metals in which advantage is taken of the heat generated by the electric current. The chief advantage of electric welding over older methods consists in the complete localization of the heat. Either continuous or alternating currents may be used, but it is a simpler matter to generate the enormous currents necessary to the welding process by means of alternating current apparatus. A dynamo of the customary

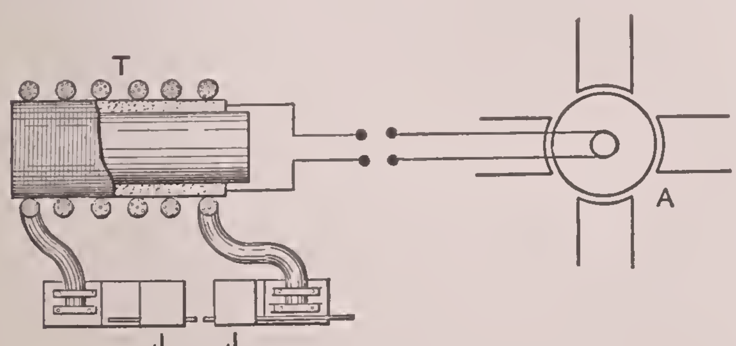


FIG. 1.

form (A, Fig. 1) is used in a circuit with a "step down" transformer, T, which reduces the voltage to very small values with corresponding increase of the current. The quantity of current will frequently, for short intervals of time, rise to thousands of ampères. A coil of variable self-induction, technically known as a "choking coil" or "dimmer," is placed in the circuit. It affords a very complete device for regulation.

When two pieces of metal are to be joined they are firmly clamped within the jaws of the welding-machine (J J). These are insulated from one another, and they form the terminals of the secondary circuit of the transformer. The pieces are then brought into imperfect contact and current begins to flow, developing heat in the only portion of the circuit which offers high resistance, i. e. at the junction of the metals. This region is brought into incandescence and to fusion so promptly that but little heat is dissipated by conduction, even in the case of where massive bars are being welded. The joint is made good by end pressure applied at the proper instant, for which purpose the jaws of the welding-machine are further thrust together. The re-

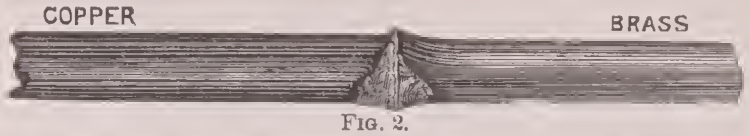


FIG. 2.

FIG. 3.

FIGS. 2 and 3.—Electrically welded joints between brass and copper rods. In Fig. 3 the metal is cut away to show the character of the junction.

sult is a slight enlargement of the joint. Figs. 2 and 3 show the form of junction produced between brass and copper by electric welding.

Electric welding has been introduced into a considerable number of manufacturing operations, even where the welding involves the heating of large masses of metal. Well-known instances are the welding of pipes, of steel rails, and of heavy projectiles and guns.
E. L. NICHOLS.

Electro-ballistics: See the Appendix.

Electrocution [a barbarous newspaper coinage which has come into common use]: infliction of capital punishment by the shock of an electric current, as enacted by the Legislature of the State of New York (Chap. 489), approved by the Governor June 4, 1888, and amended by Chap. 16 of the laws of 1892. A number of persons have suffered the death penalty in this manner, the first of whom was one Kemmler, a murderer, at Auburn, Aug. 6, 1890.

The apparatus used in the Kemmler execution, as described by Dr. C. F. MacDonald in his official report, consisted of a stationary engine, an alternating-current dynamo and exciter, a voltmeter with extra resistance coil, calibrated for a range of from 30 to 2,000 volts, an ammeter for alternating currents from 0·10 to 3 ampères, a Wheatstone-bridge rheostat, bell-signals, and necessary switches, a "death-chair" with adjustable head-rest, binding-straps, and two adjustable electrodes. The dynamo was an alternating-current dynamo intended to supply 750 incandescent lamps of sixteen candle-power each, and capable of generating, as shown by careful tests made several months prior to the execution, a maximum electromotive pressure of 2,376 volts, the commercial and mean voltage being 1,680 and 1,512 respectively, the speed of the dynamo being 1,900 revolutions, and of the exciter 2,700. The chair, a square-framed oaken one, with a high slightly sloping back and broad arms, was fastened to the floor, the feet of the chair being properly insulated. Attached to the back of the chair above the head-rest was a sliding arrangement shaped like a figure 4, the base or horizontal arm of which projected forward, and from which was suspended the head electrode, so as to rest on the vertex of top of the head, against which it was firmly held by means of a spiral spring. The spinal or body electrode was attached to the lower part of the back of the chair, and projected forward horizontally on a level with the sacrum. The electrodes each consisted of a bell-shaped rubber cup, about 4 inches in diameter, the part corresponding to the handle of the bell being of wood, through the long axis of which the wire passed into the bell terminating in a metallic disk about 3 inches in diameter, and faced with a layer of sponge. The lower electrode was also provided with a sliding arrangement and spiral spring to hold it in place, while a broad strap fastened to the back of the chair, and passed round the lower part of the prisoner's abdomen, rendered the contact secure. The head was firmly secured by means of conjoined broad leather bands, which encircled the forehead and chin, concealing the eyes and upper portion of face, and were fastened to the back of the almost perpendicular head-rest, while the chest, arms, and legs were secured by broad straps attached to corresponding portions of the chair. The wire attached to the head electrode descended from the ceiling, and that of the lower one passed along the floor to the chair, being protected by a strip of wood. The dynamo and engine were located in one of the prison shops, several hundred feet from the execution room; the voltmeter, ammeter, switch-board, etc., were located in a room adjoining the execution-room, which contained the death-chair, electrodes, and connecting wires.

Communication between the meter-room and dynamo-room was by means of electric signals. The apparatus used in all the subsequent executions at Sing Sing and Auburn was substantially a duplicate of that described, except as regards the location of the measuring instruments, switch-board, etc., and the form and points of application of the electrodes.

In the execution of Kemmler the voltmeter, ammeter, and switch-board, etc., were not in the execution chamber; hence there is no official record of the electromotive pressure and current-strength at the time of making and during the continuance of the first contact. But reasoning from cases of accidental death and experiments on some of the lower animals, and also from the subsequent electrocutions, it must have been at least 1,500 volts. The ampèrage also was not recorded in this case. An account of the execution of Kemmler will give a very correct idea of all subsequent executions by electricity, except in regard to some matters of detail in the points and length of time of contact of the electrical current. After Kemmler was seated in the chair and properly strapped and the electrodes moistened, all of which time occupied about three minutes, the warden signaled the assistant in charge of the switch in the next room to turn the lever which closed the circuit and sent the deadly current through the prisoner's body. The moment the contact was made the body was thrown into a state of extreme muscular rigidity. Every muscle of the body seemed to be in a state of tonic spasm. Synchronously with the onset of rigidity, motion, sensation, and consciousness were apparently absolutely suspended, and remained so while the contact was maintained. At the end of seventeen seconds the prisoner was pronounced dead, and the contact immediately broken. When the electrical contact was broken the rigidity noted was succeeded by complete muscular relaxation; at the same time superficial discolorations appeared on the face. The body remained limp and motionless for about half a minute, when there occurred a series of slight spasmodic movements of the chest, accompanied by the expulsion of a small amount of mucus from the mouth.

There were no evidences of return of consciousness or of sensation, but in view of the possibility that life was not wholly extinct, and in order to take no risk, the current was ordered to be reapplied, which was done about two minutes after the first contact was broken. The sudden muscular rigidity noted on the first contact was observed, and continued until the contact was again broken, when the same state of complete muscular relaxation again set in. The second current lasted about seventy seconds, and toward the end was accompanied by a small volume of smoke issuing from the points of contact, due to scorching of the sponges on the electrodes. There was also some desiccation of the already dead body under the electrodes.

After this contact there was no radial pulse or heart-action, and the corneas were depressed and flaccid. The sudden and painless character of the death of the criminal was demonstrated. In point of fact the criminal was absolutely dead at the time of breaking the first current. The movements referred to have been noticed in some of the subsequent executions, and also in animals experimentally killed by electricity, and afford no evidence of conscious suffering.

These movements were very slight in comparison with those usually found after decapitation and hanging, which have sometimes been noted an hour after the execution, whereas in subsequent executions by electricity no reflex muscular action was found three minutes after the last contact was broken.

No doubt there were certain minor defects in the arrangement and operation of the apparatus used in the Kemmler execution, but notwithstanding these defects unconsciousness was instantaneous and death painless. This was clearly demonstrated in subsequent executions, four of which were witnessed by the writer. The object to be attained in the infliction of the death penalty, so far as the individual is concerned, is sudden and painless death. One celebrated electrical expert recommended the passing of the electrical current through the hands instead of vertex of skull and legs, as then the current would have a more direct paralyzing effect on the heart. In the case of McElvaine (Feb. 8, 1892) this was shown to be erroneous and not practical. It has been shown by physiologists and medical electricians that the arrest of the heart's action can be as readily effected by destroying or paralyzing the brain center, which presides over the heart's action. It has been conceded by all the medical and electrical experts present during these executions that by including the brain directly in the circuit the action of the heart would probably be quickly arrested, while at the same time all the vital centers, including that of consciousness, would be paralyzed. The brain itself is very susceptible to the influence of electricity, as is shown sometimes to an alarming extent by the passage of mild currents into it through the skull. The nerve tissues also contain an excess of saline moisture, and hence are among the best of conductors, while the amount of organic matter in live bone also renders it a fairly good conductor.

In all the executions following Kemmler's one electrode was applied so as to cover the forehead and temples, and the other to the calf of the leg, this one being the larger. The point of contact of the body electrode is not one of great importance. It may be applied to the hand, foot, or any other part. The electrodes were kept thoroughly moistened by a continuous flow from two suspended fountain syringes containing salt water. The preparations of the prisoners from the time they entered the execution-room to the closure of the circuit which rendered them unconscious varied from about four minutes in Kemmler's case to one minute and nine seconds in Tice's case (May 17, 1892). The electromotive pressure in the executions succeeding Kemmler's, as shown by the voltmeter taken by Prof. Landry, varied from 1,458 to 1,716 volts, while the ammeter showed a variation in current of from two to seven ampères. In each instance the prisoner walked deliberately to the chair, and quietly submitted to the application of the straps and electrodes. There was nothing unduly repulsive in the executions. About the only objective phenomena observed were instantaneous and complete tonic rigidity of the muscular system on closure of the circuit and marked muscular relaxation as soon as the contact was broken. The length and number of contacts varied from two contacts of seventeen and seventy-two seconds respectively in Kemmler's case to four contacts of nine seconds each in Tice's case. There were chest movements and possibly heart-beat after first contact in Kemmler's case; in Jugiro's (three contacts of fifteen seconds each, July 7, 1891), slight radial flutter; in Tice's case, none after breaking the last circuit. The length of time which elapsed from the time the condemned person entered the room until he was absolutely dead varied from about eight minutes in Kemmler's case to two minutes and forty-nine seconds in Tice's case. Executions by hanging usually required from fifteen to thirty minutes, and frequently the heart has been found beating thirty minutes after the fall of the drop. Additional time is consumed in adjusting the rope and cap and in pinioning, and frequently the victim is simply strangled.

In the opinion of C. F. MacDonald, M. D., there are abundant reasons for believing that conscious life is destroyed so rapidly by electricity that the application of the current could be repeated several times within the interval that is known to elapse between the receipt of an injury or a peripheral sensory impression and its conscious perception by the brain through the medium of the sensory nerves. In other words, the electrical current would travel from the point of contact to the brain many times faster than sensory impressions or nerve currents would—the rate of velocity of the latter being, roughly speaking, only about 155 feet per second, while electricity travels at the rate of millions of feet per second. Thus it will be readily seen that an electrical current of lethal energy coming in contact with the body so as to include the brain in the circuit would reach the latter and produce unconsciousness long before any sensory impression at the point of contact could be conveyed to and appreciated by that organ through the process of nerve-conduction, which, as has been shown, requires a distinctly appreciable period of time—the rate of transmission of painful sensations being even slower than that of ordinary tactile impressions.

This was shown very clearly by a series of experiments in instantaneous photography made by Prof. Muybridge. A careful *post-mortem* examination was held on each of the persons thus executed, but nothing, either macroscopic or microscopic, was found to show the passage through the body of the electrical current, except perhaps a slight desiccation of the skin at the points of contact of the electrodes.

Experience so far has demonstrated that the only reasonable objection to the use of electricity in carrying out a death sentence, at least so far as the individual is concerned, as compared with other modes of capital punishment, lies in the fact that the application of a current generates heat at the points of contact, and if sufficiently prolonged is attended with vesication of the skin at those points. This occurs, if at all, toward the end of the contact and long after conscious life is extinct; hence the objection is only a sentimental one. As compared with hanging, in which death is often produced by strangulation, with every indication of conscious suffering for some time on the part of the victim, electric shock is preferable both as regards the suddenness with which death is effected and the expedition with which all the preliminary details may be arranged.

R. T. Irvine.

Elec'trodes [formed from *electro-*, used as meaning electricity (from Gr. ἤλεκτρον, amber) + Gr. ὁδός, way; cf. *anode* (ἄνοδος), positive pole, *kathode* (κάθοδος), negative pole]: the surfaces by which electricity passes into and out of different media; especially the poles of the voltaic battery or pile. The so-called positive electrode is the anode, and the negative the kathode.

Electro-dynamic Engine: See Dynamo-electric Machine.

Electro-dynamics: the science which treats of the phenomena of electric currents. See Electricity.

Electro-horticulture: a term applied by C. W. Siemens, of England, about 1883, to the cultivation of plants by the aid of the electric light, and revived in 1891 by L. H. Bailey, of Cornell University, who in his experiments has found that some plants, notably lettuce, are greatly assisted by the electric light, while others are injured.

Electro-etching: See *Glyphography* under Stereotyping.

Electrol'ysis [from *electricity* and the Gr. λύω, to set free]: the decomposition of chemical compounds by the action of the voltaic current. When the electric current flows through any liquid not a chemical element, decomposition of the latter occurs, and the acid radical is separated from the metallic element with which it had been in combination. The two components into which the electrolyte (as the liquid which suffers decomposition is termed) is separated do not appear together at any one point. The acid radical shows itself only at the electrode through which the current enters the electrolytic cell, the metal only at the other electrode. At no intervening point within the liquid can any trace of either component in nascent state be discovered, nor does the electrolyte show any change of condition or properties, excepting at the surfaces of the electrodes, to indicate that it is under electrolytic action.

Electrolysis differs from chemical dissociation by heat or by other agencies in another respect—it occurs at all ordinary temperatures. Faraday, to whom we owe much of our knowledge of electrolysis, formulated the laws of electrolytic action in terms which have needed no modification. He originated many names still in use in the literature of the subject. Of these the most important are: *anode*, the electrode through which the current *enters* the cell; *kathode*, the electrode through which the current *leaves* the cell; *ion*, an element resulting from electrolysis; *anion*, the ion deposited upon the anode; *kathion*, the ion deposited upon the kathode.

Faraday's laws of electrolysis were stated by him as follows: 1. The amount of chemical action per second is directly proportional to the current strength. 2. If the same or equal currents pass through several electrolytic cells the weight of the ions set free at the several electrodes will be in the proportion of the chemical equivalents of the ions.

The amount of an ion deposited by the unit current in a unit of time is termed the *electro-chemical equivalent*. The amount of electrolysis due to the passage of a Coulomb (*q. v.*) of electricity is thus a definite quantity. For a table of electro-chemical equivalents, see article Electricity. The precise nature of the electrolytic process is not known. The best-known hypothesis is that of Grotthuss (*Physicalische-chemische Forschungen*, 1820), but this together with other and later views is to be regarded as artificial. Electrolytic processes have found extended application in analytical chemistry and in the industrial arts. They afford means of measuring current-strength also (voltametry), and make possible the storage of energy utilized in secondary batteries. See Accumulator.

For a very complete summary of facts and theories relating to electrolysis, see Wiedemann, *Elektricität*, vol. ii.

E. L. Nichols.

Electromagnetic Induction: See Induction, Electromagnetic.

Electro-magnetism: See Electricity.

Electro-metallurgy: See Electrotype.

Electrometer [formed from *electro-*, used as meaning electricity (Gr. ἤλεκτρον, amber) + Gr. μέτρον, measure]: an instrument for the measurement of differences of potential by means of electrostatic forces. Potential galvanometers and voltmeters, which are also employed for the determination of potential differences, depend for their action upon the electromagnetic effect of the current; these, therefore, are not to be classed as electrometers.

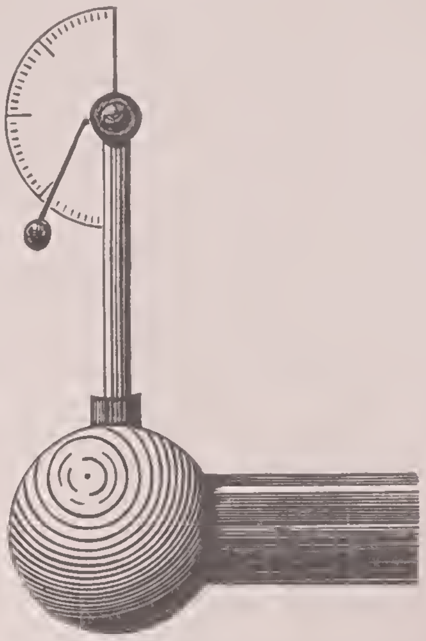


Fig. 1.

Electrometers may be conveniently divided into three classes: (1) modifications of the electroscope, (2) absolute electrometers, (3) quadrant electrometers.

To the first class belongs Henley's electrometer (Fig. 1) which is simply a pith-ball electroscope, provided with a vertical scale for reading the deflection of the ball. It is a rough instrument, and of use only as an indicator of the approximate condition of heavily charged conductors. Peltier's electrometer (Fig. 2) and the Coulomb balance may also be regarded as developments of certain forms of electroscope.

In Peltier's instrument the deflection of a pivoted rod was read upon a circular scale; in the Coulomb balance the electrical forces were measured by means of the torsion of the suspension fiber. Both instruments have been superseded by the more accurate and convenient quadrant electrometer.

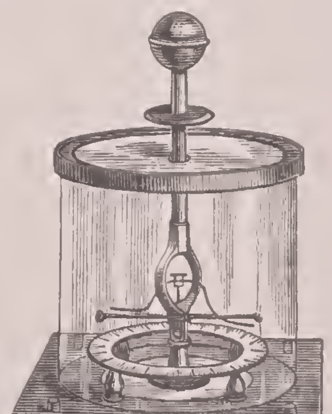


Fig. 2.

Absolute electrometers depend upon the principle that the force between an area S of an electrified plane conductor at potential V, and a parallel plane conductor (b b) at potential O, is

$$F = \frac{V^2 S}{8 \pi d^2},$$

where d is the distance between the two planes (see Fig. 3). This law holds only when d is small compared with the surfaces of the two planes, and the area S is situated at a considerable distance from the edge of the plane in which it lies.

Lord Kelvin (Sir William Thomson), to whom in great part the perfection of the absolute electrometer is due, meets these conditions by the device known as the guard ring. The area S is cut out from the remainder of the plane and is pivoted with the freedom of movement at right angles to the plane (Fig. 4).

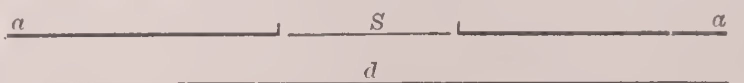


Fig. 3.

The remainder of the plane is fixed and serves as the guard ring. The parallel plane is moved by means of a micrometer screw, thus varying the distance d, until the force F between the attracted disk and the parallel plane is sufficient to bring the former to a selected position (the zero of the index). The difference of potential between the planes is thus measured.

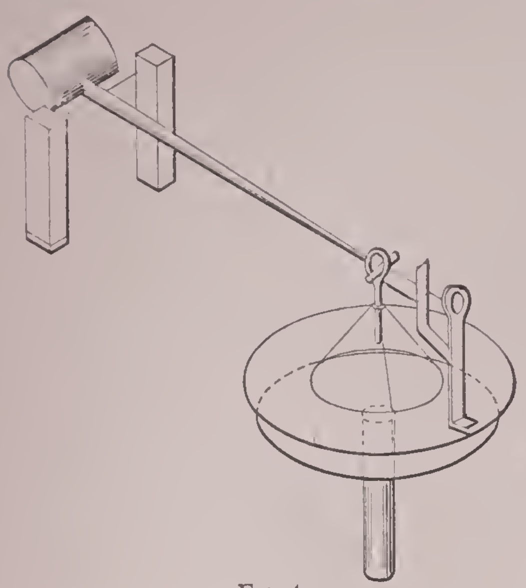


FIG. 4.

A far more sensitive instrument is the quadrant electrometer, one of the simplest forms of which is shown in Fig. 5. The essential parts are the needle, which is simply a strip of metal, and the quadrants. The former is very light and thin, mounted in a flat cylindrical box (Fig. 6), or sometimes above a divided disk, as in Fig. 5. The box is cut into quadrants which are separated from one another by an air-space sufficient to give complete insulation. Each quadrant is mounted upon a glass post. The needle, swinging in the center of the box, touches none of the quadrants. The suspension is usually bifilar, although in some forms of the instrument the torsion of a single suspension fiber is substituted. The normal position of the needle with reference to the quadrants is shown in Fig. 6. The quadrants are connected pairwise by wires diagonally across, 1 with 3 and 2 with 4.

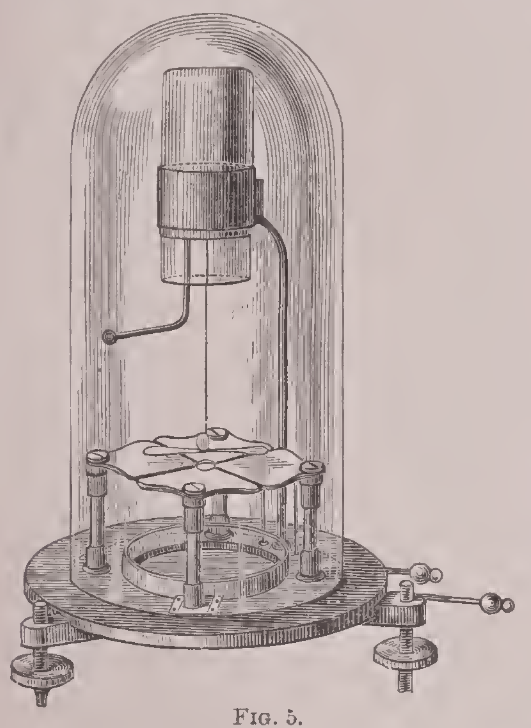


FIG. 5.

The quadrant electrometer may be used in four ways:

(1) The needle is given a large constant charge and the quadrant pairs are brought to the potentials, the difference of which is to be measured. The deflection of the needle is then determined by the method of the mirror and scale.

The following is the law of the instrument thus used:

$$\text{Sin } d = \frac{c}{C}(V_1 - V_2)V_n,$$

where d is the deflection; $\frac{c}{C}$ is a constant depending upon the dimensions and adjustment of the quadrants and needle and upon the bifilar suspension; V_1 and V_2 are the potentials of the quadrant pairs; and V_n is the potential of the needle.

To hold the needle at the high potential necessary to great sensitiveness Lord Kelvin (in the Thomson electrometers) mounted the needle and quadrants upon a Leyden jar, the inner coating of which consisted of strong sulphuric acid. The needle was connected with the inner coating by means of a fine platinum wire which dipped into the acid, and thus always shared the electrification of the jar. For the extremely ingenious devices by means of which the charge of the needle is replenished and gauged, and the sensitiveness of the instrument is varied, the reader is referred to the monograph *On Electrometers* (Thomson's *Papers on Electrostatics and Magnetism*), or to *Encyclopædia Britannica* viii., p. 117, or to Gray's *Absolute Measurements in Electricity and Magnetism*, vol. i.

(2) In the second method of using the electrometer the quadrant pairs are given a large potential-difference and the body, the potential of which is to be measured, is connected with the needle. The same formula applies.

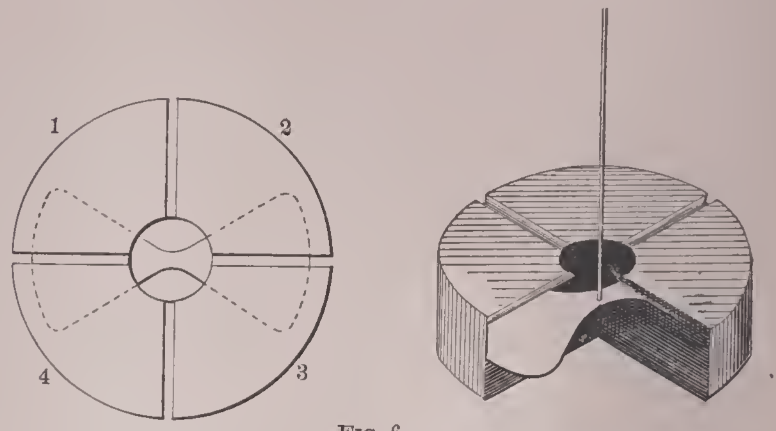


FIG. 6.

(3) In the third method the needle is connected to one quadrant pair. The formula then becomes:

$$\text{Sin } d = \frac{c}{2C}(V_1 - V_2)^2,$$

where $V_1 - V_2$ is the difference of potential between the quadrant pairs.

(4) In the fourth method the quadrant pair which is not connected with the needle is brought to zero potential (earth). The formula becomes:

$$\text{Sin } d = \frac{c}{2C}V^2.$$

Methods 2 and 3 are of small sensitiveness, but they have the advantage of being applicable to the measurement of alternating potential differences.

Valuable modifications of the Thomson electrometer have been made by Kirchhoff, Mascart, Carpentier, Ryan, and others, and an entirely different principle has been introduced by Lippmann in his "capillary electrometer." In this instrument advantage is taken of the movement of a mercury column in a small tube (owing to changes of the surface tension when electrified), and it is found possible to measure very minute differences of potential (·0001 volts). See ELECTRICITY, ELECTROSCOPE, etc. E. L. NICHOLS.

Electroph'orus [from *electro-* (Gr. ἤλεκτρον, amber), used as meaning electricity, + Gr. -φορος, bearing, deriv. of φέρειν, to bear]: the simplest form of apparatus for the continued production of electricity by electrostatic induction. It consists of a disk of vulcanite, sulphur, or of some resinous composition, and a metallic disk of smaller diameter with an insulated handle. The resinous surface having been electrified by friction, the metallic disk is placed upon it. The latter is then momentarily connected with the earth to allow of the escape of the negative charge, which, having been generated by the inductive action of the resinously electrified surface below, is repelled and escapes to the ground. The metallic disk then possesses a positive charge, which may be removed by withdrawing the disk from its resinous bed, and may be utilized in charging Leyden jars, etc. Since in this cycle of operations, which is known as the electrophorus cycle, and which is performed automatically in influence machines, accumulators, and replenishers, the original charge is not depleted, the performance may be repeated as often as is desired without recharging the resinous plate. The source of the electrical energy thus developed lies in the work which must be done in removing the positively charged disk from the neighborhood of the negatively electrified plate upon which it has been lying during the first portion of the cycle. See ELECTRICITY.

E. L. NICHOLS.

Electro-plating: the covering of the surface of articles formed of the cheaper metals with gold, silver, platinum, nickel, copper, or other costly metals by means of the electric current, on the same principle as that which is employed in electrotyping. German silver is one of the best substances to receive an electro-plate, though copper and its alloys are excellent. If iron, zinc, or pewter were to be used, they were formerly first plated with copper, but improvements render that unnecessary. All articles to be plated are most carefully cleaned and scoured. They are then dipped in a solution of nitrate of mercury, and receive therefrom a thin film of mercury, which causes the plate to adhere firmly. The bath of silver, gold, or platinum contains 100 parts of water, 10 of potassium cyanide, and 1 of the cyanide of the precious metal to be employed. The articles to be plated are suspended in this bath, and treated as described in the article ELECTROTYPE (*q. v.*). After removal, they are brushed and burnished. The above account is necessarily very general, for though the principle is simple, there are in practice many details which require careful attention in order to secure success. This process is of great importance in the arts, one of its applications being the operation of nickel-plating. There is much literature on electro-plating. See Urquhart's *Electro-plating* (London), Hiorns's *Metal-coloring and Bronzing* (London), and Brunor's *Practical Electro-plater* (New York, 1893).

Electroscope [from *electro-*, electricity (Gr. ἤλεκτρον, amber) + Gr. -σκοπός, observing]: an instrument for indicating electrification. The forces between charged bodies are either repellent or attractive, and both are made use of in the electroscope. The form generally employed is shown in Fig. 1. It consists of a pair of gold leaves attached to the lower end of a vertical metallic rod. For protection the leaves are mounted within a metal box with glass windows. The rod which terminates without in a ball or disk is carefully insulated from the case by means of a layer of shellac or glass. When a charged body is brought near to the disk or knob, the latter, together with the gold leaves, is acted upon inductively, and the leaves diverge. Used in this way the electroscope indicates electrification, but does not show the character of the discharge. If the leaves be given a permanent charge, the instrument will indicate the *sign* as well as the *relative degree* of excitation of any charged body brought near. Bodies of similar electrification to the electroscope will then increase the dilation of the leaves; those with the charge of opposite sign will draw the leaves together. This form of electroscope was first described by Bennet (1787).

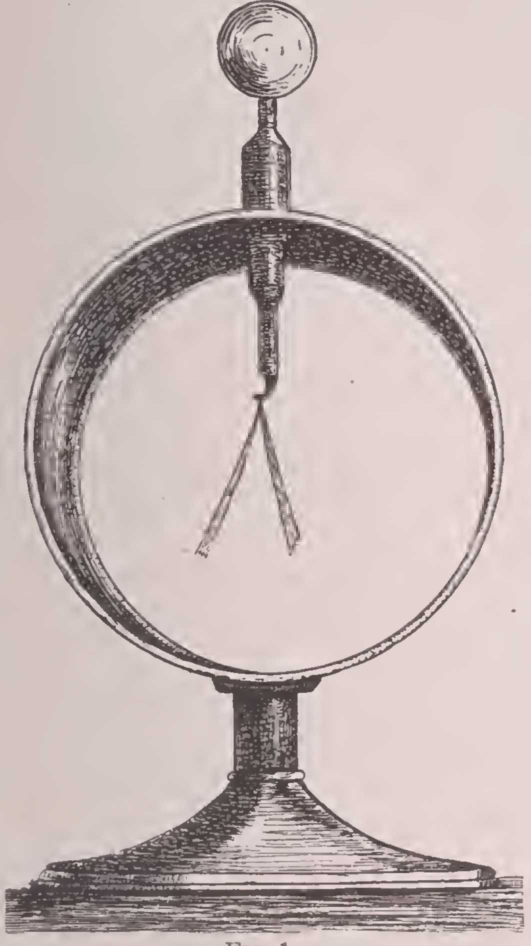


FIG. 1.

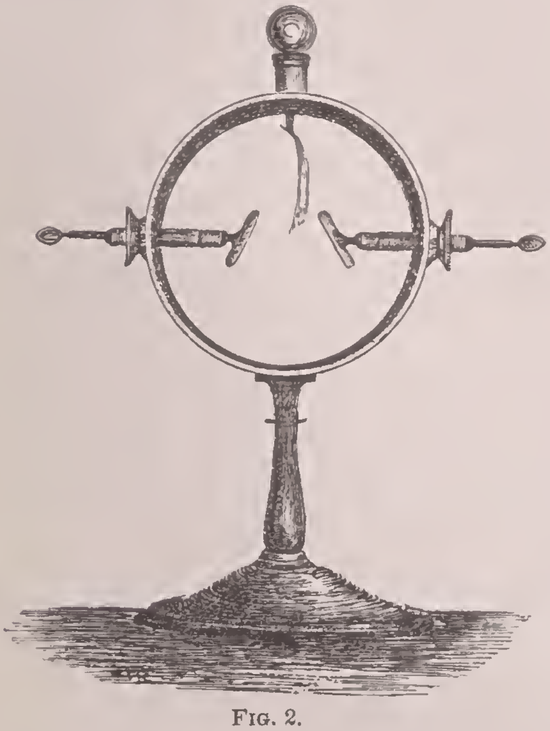


FIG. 2.

Another type of electroscope (Fig. 2) contains but one strip of gold leaf, which hangs vertically between two terminals of polished metal. These are inserted through the opposite sides of the electroscope-case, from which they are insulated. These terminals are brought to a considerable potential-difference by connecting them with the poles of a battery of many cells, usually of a voltaic dry-pile. If the gold leaf is not electrified, and if it is situated midway between the terminals, it will be acted upon by equal and opposite forces, and although in nearly unstable equilibrium it will maintain its position. The presence of even a minute charge upon the gold leaf (which may be imparted either by induction or by contact from without) will subject it to attractive forces on one side and forces of repulsion on the other, and it will be drawn toward the terminal, the electrification of which is opposed to its own.

The electroscope just described was first used by Bohnenberger (1819), who maintained the charge of the terminals by means of a dry pile. In the hands of Hankel, who substituted a hundred cells of water battery for the dry pile, and observed the deflections of the gold leaf through a reading microscope (see Wiedemann's *Elektricität*, i., p. 162; also *Annalen der Physik*, 84, p. 28), the Bohnenberger electroscope was rendered capable of accurate quantitative indications. Hankel's modification should therefore be classed as an electrometer.

In cases where considerable charges are to be studied much less sensitive devices may be made to serve as electroscopes. A pith ball hung by a silken thread, a rod of vulcanite or of sealing-wax suspended in a stirrup, even a lath balanced upon a point, may be used. See ELECTRICITY and ELECTROMETER. E. L. NICHOLS.

Electrotype [formed from *electro-* (Gr. ἤλεκτρον, amber), used as meaning electricity, + *type*, from Gr. τύπος, image, figure]: the cast of an object procured by the gradual deposition of a metal from a solution by means of a current of electricity. When two pieces of clean platinum are put into a solution of sulphate of copper, no change takes place. But if an electric current is transmitted through the solution by means of these platinum plates, copper is at once precipitated upon the plate which forms the kathode, the anode remaining clean. If the current be reversed, the copper will be transferred from the platinum plate on which it had been deposited to the clean plate. By thus reversing the direction of the current the copper may be sent backward and forward, being always deposited upon the negative pole, or that surface by which the electric current leaves the electrolyte or solution that is undergoing decomposition. By continuing the electric currents, and keeping up the strength of the solution by adding fresh portions of the salt of copper, the metallic film on the kathode may be made of any required thickness, and afterward peeled off the platinum surface. The texture of the copper deposited varies with the battery-power employed and with the strength and temperature of the solution, and may be hard, brittle, and crystalline, or tough and malleable, according to the management of the operator. A current of low intensity, a moderately strong solution of sulphate of copper acidulated with sulphuric acid, and a temperature not below 60°, are the most favorable circumstances for obtaining the best deposit of copper. When the negative pole or kathode is irregular (like a coin or medal), instead of being a plane surface of platinum, an exact impression of the device may be taken off on the precipitated copper. Gold and other metals may be substituted for copper by proper management, or if the precipitated metal be left upon the surface on which it is thrown down, gilding, silvering, etc., may be done extensively and with fine effect. This art is called electro-plating. Proficiency in electrotyping or the galvano-plastic art requires but little apparatus, and involves no great expense. A medal may be either copied directly, and an inverted impression obtained from which a second electrotype can be taken, or a cast of the metal may be first made in stearin or plaster. In the latter operation, which is the most generally used, the mould, if of plaster, must be first soaked in oil, tallow, or melted spermaceti, so as to render it impervious to water. It must then be made a conductor of the current, and this is done by thoroughly brushing black lead over the surface which is to be reproduced. In case the medal itself is used, in order to prevent the deposition of copper which would take place upon the edges and upon the reverse of the medal, those parts should be covered with sealing-wax, varnish, or shellac. The introduction of this valuable art has been ascribed to different persons. Daniell is said to have been the first to notice the deposition of metallic copper by electricity while working with his battery; Jacobi, of St. Petersburg, first published in 1839 a practical application of this fact, which publication called out announcements from Spencer and Jordan, two Englishmen, who were both working independently at the same object as Jacobi. Messrs. Elkington, of Birmingham, soon after applied the process to the gilding and plating of goods on a large scale. Electrotyping has to some extent superseded the old stereotype process for making plates for printers' use, especially for the reproduction of engravings and where large numbers are to be printed. For a summary of the various processes used by printers in the departments of stereotyping and electrotyping, see STEREOTYPING.

Electrum [Lat. = Gr. ἤλεκτρον, amber]: a natural alloy of gold and silver, in the proportion of two of gold and one of silver. It is found in Siberia, Norway, and California, and occurs in tabular crystals or imperfect cubes of a silver-white color.

Electuary [from Late Lat. *electua'rium* (also *electa'rium*), a deriv. from a corrupted form of Gr. ἐκλεικτόν, cf. ἔκλειγμα, derivatives of ἐκλείχειν, lick up. The word appears in Ital. *lattovaro* (under the influence of *latte*) and in Germ. as *Latwerge*]: in pharmacy, a variety of confection thinner than a conserve, and composed of powdered drugs mingled with honey, sirup, glycerin, or other vehicle. Electuaries are not now recognized in the U. S. and British pharmacopœias.

Elegiac Distich: a couplet consisting of a dactylic HEXAMETER and a PENTAMETER (*qq. v.*). The second verse repeats the movement of the hexameter, as if reconsidering it. Hence its reflective, emotional character. Schiller's famous distich is translated by Coleridge thus:

In the hexameter rises the fountain's silvery column;
In the pentameter aye falling in melody back.

The elegiac distich was the first step toward the STROPHE (*q. v.*), and was used in the elegy (ἐλεγεῖον), the poetry of subjective reflection. As to the inventor, the ancients did not agree. There are extant elegies, or fragments of them, by some fifty poets, from Callinus (730 B. C.) down; but the period specially marked by elegiac composition closes not long after Theognis (540 B. C.), of whom we have about 1,400 verses. This form of poetry was much used in epigrams, epitaphs, etc. The chief Roman elegists are Catullus, Propertius, Tibullus, and Ovid. MILTON W. HUMPHREYS.

Elegy [viâ Lat. *elegi'a*, from Gr. τὰ ἐλεγεῖα, an elegiac poem, a lament, collec. plur. of ἐλεγεῖον]: the name given by the ancient Greeks and Romans to poems of various kinds, being applied to the martial lyrics of Tyrtæus, the aphorisms of Theognis and Solon, the melancholy effusions of Mimnermus, and the erotic poems of Ovid, Catullus, and Tibullus. In modern times the name is applied chiefly to poetical compositions of a melancholy character, such as Gray's *Elegy Written in a Country Churchyard.*

Element [from Lat. *elementum*, a constituent or fundamental part: the word possibly originated in the names of the letters, *l, m, n.* i. e. *el-em-en-tum*, and was afterward felt to be a noun with the common suffix *-mentum*; cf. Eng. *a b c's*, pron. *ābeeseez'*, or it may be connected with Skr. *ánimaṅ-*, smallest piece]: a term used in various senses; a first principle; a rudiment; a constituent part of a compound; sometimes the proper state or sphere of a person or an animal. In the plural, the first principles or rules of a science or art; also the bread and wine in the Eucharist. Ancient philosophers applied this term to fire, air, earth, and water, each of which, in their several systems, was supposed to be the first principle of all things. The elements of the alchemists were sulphur, mercury, and salt. As a modern scientific term, *element* signifies a simple substance, or one which chemists have not yet decomposed.

ELEMENTS: in astronomy, the data required to compute the place of a planet, satellite, or comet; numerical quantities, etc., employed in the construction of tables exhibiting the motions of the moon and planets. They comprise the least mean distances of the planets from the sun, the eccentricity of their orbits, their mean motions, their masses, etc.

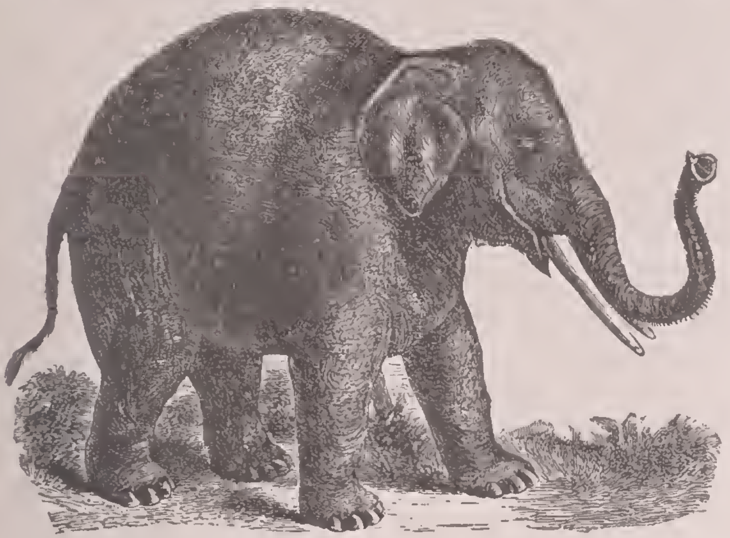
ELEMENTS, CHEMICAL: See CHEMISTRY.

Elements, New Chemical: See the Appendix.

Elemi [cf. Fr. *élémi*, Span. *elemi*, Ital. *elemi*; the word is of Eastern origin]: a fragrant resinous substance procured from several species of trees of the natural order *Amyridaceæ*. It exudes from incisions made in the bark, is at first soft, but becomes hard and brittle. It is generally pale yellow, semi-transparent, and soluble in alcohol, except a residue called *elemin*. It is obtained from the *Icica icicariba*, which grows in Brazil; from *Elaphrium elemiferum*, of Mexico; and from *Canarium commune*, of Manilla. Elemi is used in the preparation of ointments and plasters.

Elephant [from Lat. *elephantus*, or *elephas*, from Gr. ἐλέφας, -αντος; origin obscure]: the common name of the members of the sub-family *Elephantinæ*, a group of thick-skinned mammals of the order *Proboscidea*, distinguished among living mammals by the possession of a long trunk, or proboscis, forming a prolongation of the nose. The head is large and rounded, and, owing to the shortness of the neck, seems to be set directly on the shoulders. The limbs are straight and massive, the ears large, flattened, and in repose carried along the side of the neck; the dark wrinkled skin is nearly naked, being sparsely sprinkled with black hairs, while the end of the tail bears a tuft of coarse whalebone-like hairs. The dentition is remarkable. There are but two incisors; these, which are in the upper jaw, are the successors of two small milk incisors, and grow throughout life as two pointed, slightly curved tusks. In many of the Asiatic elephants, however, the tusks are poorly developed. The tusks consist of that fine-grained, elastic modification of dentine termed ivory.

The grinders are formed of vertical, transverse plates of enamel, arranged in compressed U-shaped folds, imbedded in dentine, and having the hollow of the U filled with cement. During the life of an elephant there are altogether six molars on each side of each jaw, but, owing to the peculiar mode of their succession, not more than one entire tooth and part of another is in place and in use at any one time. The teeth are not developed one below the other, as in mammals generally, but one behind the other, the tooth in use moving slowly forward in the jaw, being replaced by the one which forms at its back. The lower jaw is very heavy, and is loosely articulated with the cranium, being, as it were, suspended by the large masticatory muscles. While the upper bones of the legs are unusually long, the bones of the feet are small and imbedded in a mass of tough spongy tissue, which forms an elastic pad and renders the step of these huge beasts springy and noiseless. The bones of the forearm are crossed one over the other, and there is no round ligament (*ligamentum teres*) running from the center of the thigh bone to its socket. The head of the elephant is large, but this is not due to the size of the brain, this being comparatively small, but to the necessity for providing surface for the attachment of the muscles which form the trunk, and for those which sustain the weight and leverage of the trunk and tusks. A large portion of the skull is formed of bony air-cells which give great increase in bulk, with but slight additional weight, and these constitute so large a proportion of the cranium that a ball may—and frequently does—pass entirely through the head without causing death. The most striking feature of the elephant is the trunk, which, formed of thousands of interlacing muscles and capable of the most varied movements, compensates for the shortness of the neck and enables the animal to reach objects far above his head or lying on the ground at his feet. With it he conveys food to his mouth, or drinks by drawing up water in the nostrils and discharging it into his mouth, a peculiar valve-like arrangement preventing the water from reaching above a certain point in the proboscis. The trunk of the Asiatic elephant is provided with a little finger-like projection, but the African species has none. In the case of the African species, which furnishes the bulk of the ivory of commerce, the tusks, although weapons of defense, bid fair to be the cause of its extermination, from 75,000 to 100,000 animals being killed annually. As the animal grows but slowly, and as Africa is being yearly rendered more and more accessible, the end can not be very far off. Tusks have been obtained 9 or 10 feet in length, and 150 lb. in weight, but such are rare, the average weight of tusks from Africa now brought to market being about 30 lb., that of tusks from India much less. Elephants are polygamous, and usually associate in small herds, although formerly the African species was found in great numbers. The period of gestation is twenty-one months, and the female brings forth but one young at a birth, the baby elephant being about 3 feet high and from 150 to 200 lb. in weight. The rate of growth is slow, an elephant requiring from twenty to thirty years to attain its full stature and full weight, this latter varying from 6,000 to 9,000 lb. Its food is strictly vegetable, consisting of the twigs and leaves of trees, shoots of young bamboo, grass, and aquatic plants. There are but two species of existing elephants, the Asiatic and the African, these being the sole survivors of a race that once ranged over the greater portion of the earth and whose fossil remains bear testimony to former abundance. The Asiatic elephant (*Elephas indicus*), the species most commonly seen, is distinguished from its African relative by a greater



Asiatic elephant (*Elephas indicus*).

number of enamel plates in the grinders, the flatness of the forehead, smaller size of the ears, a greater number of folds in the trunk, and by having four nails on the hind foot instead of three. The Asiatic elephant reaches an extreme height of 10 ft. 6 in., or possibly 11 feet, but 8 ft. 6 in. is above the average. The females are but little less in size than the males, but have smaller tusks often not showing at all. It inhabits the forest lands of India, Burma, the Malay Peninsula, Cochin China, Ceylon, Sumatra, and Borneo. The Bornean elephants are believed to be the descendants of some presented by the old East India Company to the Sultan of Sulu, and by him turned loose in Borneo.

The African elephant (*Elephas* or *Loxodon africanus*) is found in nearly all the wooded regions of Africa S. of the Sahara. The males attain a maximum height of 12 feet, but the females are usually decidedly smaller than the males. While the Asiatic elephant has been tamed by man since time immemorial, it has never been domesticated, it being easier to capture and subjugate wild elephants than to breed them in captivity. Elephants formerly played a prominent part in the wars and state ceremonials of East Indian potentates, and are to-day used by them in hunting tigers and other game, and to swell the pomp and circumstance of their state. They are used in the British Indian forestry department, and in the East Indian army for the transportation of artillery and military stores. The cost of maintaining an elephant is considerable, for, in addition to the large amount of food consumed, each animal requires five or six attendants and two or three buffaloes and a pony to bring in fodder from the forest. In the teak forests the elephants drag and pile up the hewn timber, laying the heavy beams as regularly and as skillfully as men. Elephants are captured by being driven into a strongly built inclosure, where they are secured and fastened to trees by the aid of tame elephants, and left until subjugated by fatigue and hunger. The capture or killing of wild elephants is prohibited by law throughout India, and in Ceylon there is also an export duty placed upon them.

Since the days of Hannibal, when the Carthaginians employed elephants in their wars with Rome, no African race has had the ability to capture and train these huge beasts, although the African elephant in captivity seems to be quite as intelligent as its relative of India.

Extinct elephants are described under MAMMOTH and MASTODON (*qq. v.*), but it may be said that the fossil species seem to have varied quite as much in size as their modern representatives, and that while their tusks were larger they do not appear to have exceeded in bulk the largest representatives of the living species. F. A. LUCAS.

Elephan'ta: an island of British India; in the harbor of Bombay, 7 miles from that city. It is 6 miles in circumference, and contains several remarkable ancient cave-temples excavated out of the native rock, and adorned with numerous sculptured figures of the Hindu mythology. The largest of these cave-temples is about 133 feet long, and is supported by twenty-six pillars. A gigantic stone figure of an elephant formerly stood on the shore, and from this the island received its name.

Elephant Bay: an inlet of the Atlantic; in Benguela, Africa; lat. 13° 14′ S., lon. 12° 33′ E. It affords good anchorage, but no fresh water.

Elephant-beetle: a name popularly applied to various lamellicorn beetles of the genera *Goliathus*, *Megasoma*, and *Dynastes*, either on account of their great size or from their long snout-like projections of the head. F. A. L.

Elephant-fish: a name applied to the southern chimæra (*Callorhynchus antarcticus*) on account of the curious prolongation of the snout, which suggests a proboscis and is somewhat prehensile. It is found in the Southern Pacific, especially in the vicinity of the Cape of Good Hope, and is occasionally eaten. F. A. L.

Elephanti'asis [Gr. ἐλεφαντίασις, a cutaneous disease, so called from the resemblance of the diseased skin to the elephant's hide]: the disease anciently known as *elephantiasis Arabum*, the elephantiasis of the Arabians, so called to distinguish it from the *elephantiasis Græcorum*, the elephantiasis of the Greeks, which was probably identical with leprosy. Elephantiasis is rare in Europe and North America, though not unknown in either. It is endemic in the Levant and the East and West Indies, whence it is often called *Barbados leg*. The foot and leg, or sometimes other parts, become greatly enlarged and enormously increased in density and hardness, the skin assuming a remarkable roughness and usually a darkness of hue. It is sometimes caused by a small animal organism, the *Filaria sanguinis hominis*, which, in its adult state, infects the lymphatic vessels or glands, especially in the groin, and by obstructing the flow of lymph finally leads to the swelling of the limb. The prognosis is usually grave, very few cases recovering, though many cases remain completely stationary after the disease is once established. In fatal cases suppuration and erysipelas are the active symptoms. The treatment is thus far unsatisfactory. The use of iron, iodine, and quinia, with bandaging, is recommended. Revised by W. PEPPER.

Elephan'tiné: an island of the river Nile; on the boundary between Egypt and Nubia; opposite Assouan (the ancient *Syene*). It is a mile long, and is partly occupied by gardens and houses interspersed among ruins of ancient temples erected by the Pharaohs. Among its monuments is the Nilometer mentioned by Strabo, and designed to record the height of the inundations of the Nile. It was long an independent city, with its own kings, and gave to Egypt the fifth dynasty; its modern inhabitants are all Nubians. See EGYPT, ANCIENT.

Elephant Seal, or **Sea-Elephant**: the name applied to the two largest members of the hair-seal family (*Phocidæ*), partly on account of their great size, but more from the fact that the adult males have a short proboscis. The male southern elephant seal (*Macrorhinus leoninus*) is, when fully grown, about 16 feet in extreme length, or 20 feet from tip of nose to end of outstretched hind flippers. The color is gray, with a blackish or olive cast, darkest above. The head is large, external ears absent. There are five nails on the fore foot, none on the large webbed hind feet, which, as in the other hair seals, are the chief organs of propulsion. The females are but one-half or one-third the bulk of the males. The food of the animal is mainly cuttlefishes. The southern elephant seal is most abundant at Kerguelen, Heard, and Macquarie islands in the southern seas, where they have long been hunted for their oil. Their numbers have been greatly lessened, and the profit of a sea-elephant voyage is now uncertain. The northern elephant seal (*Macrorhinus angustirostris*), which very closely resembles that of the south, was once abundant on the coast of Lower California, but has been probably exterminated. F. A. L.

Elephant's Foot: a plant (*Testudinaria elephantipes*) sometimes called Hottentots' bread. It belongs to the family *Dioscoriaceæ*, having a large, fleshy root-stock, abruptly truncated at the end. This root-stock is eaten by the Hottentots. It is covered with a soft, rough bark, from which springs a climbing stem, bearing the leaves and flowers. The same name is also given to a genus of the family *Compositæ*, the *Elephantopus*, of which a few species are found in the U. S.

Elephant-shrew: a name applied to various members of the family *Macroscelidæ*, on account of their elongate noses. This group of insectivorous mammals is peculiar to Africa, and its members are distinguished by their long hind feet and jumping abilities. In habits and appearance they some-

Elephant-shrew (*Macroscelides typicus*).

what resemble the jumping-mice of North America, and are sometimes locally termed elephant-mice. F. A. L.

Elets: a town of Russia; government of Orel; on the Sosna; 220 miles S. S. E. of Moscow (see map of Russia, ref. 8–E). It has many factories, and a large trade in leather, grain, and flour. Pop. (1897) 37,455.

Eleusi'ne: a genus of grasses (*Gramineæ*), comprising several species which are natives of India and other warm climates, and are cultivated for food. *Eleusine coracana* is extensively cultivated for its large farinaceous grain (called korakan or dagussa) in India, China, Japan, and throughout Africa. The *Eleusine indica* is naturalized about dooryards, etc., in the U. S.

Eleusin'ia, or **Eleusinian Mysteries**: an annual festival celebrated in ancient Greece in honor of Demeter (Ceres) and Persephone (Proserpine). The worship of Demeter originally took place at Eleusis only, but after the conquest of that city by the Athenians feasts were celebrated in her honor in various Grecian cities. The origin of these mysteries is uncertain, but the popular tradition was that Demeter herself, while searching for her daughter Persephone, came to Attica, where she taught the inhabitants the use of corn and instituted the mysteries. The festival consisted of the greater and the lesser mysteries. The lesser feast was held in the spring at Agræ, on the Ilissus, and was only a preparation for the real or greater mysteries. The latter took place in October. On the first day, called ἀγυρμός (the assembling), the mystæ—i. e. those who had been initiated in the lesser Eleusinia—assembled at Athens. On the second they walked to the sea in procession and were purified. The third day appears to have been a day of fasting, and, according to some authorities, sacrifices of fish and cakes of barley from the Rarian plain were offered. On the fourth day the procession of the sacred basket (κάλαθος κάθοδος) took place. This basket contained pomegranates and poppy-seeds, and was drawn on a cart by oxen, and followed by women bearing mystic cases. The fifth day appears to have been known as the torch-day, and probably symbolized the search of Demeter for Persephone. The mystæ walked with torches to the temple of Demeter at Eleusis, where they seem to have remained all night. The sixth day, called Iakchos, from a son of Demeter, was the most solemn of all. A decorated statue of Iakchos was carried from Athens to Eleusis, where the votaries again passed the night and were initiated into the last mysteries. Under an awful oath of secrecy they were admitted into the inner sanctuary, where they were allowed to see the sacred things, after which they were called *epoptæ*—i. e. watchers. On the seventh day they returned to Athens with jests and music, resting at the bridge over the Cephisus, where they ridiculed all who passed. The eighth day is supposed to have been added to the original number, so that those might be initiated who had been unable to attend on the sixth day. On the ninth and last day two vessels filled with wine or water were emptied—one toward the east, the other toward the west—by the priests, who at the same time uttered some mystical words. Besides these ceremonies there were several others, of which the Eleusinian games, supposed to have taken place on the seventh day, and to have been the most ancient in Greece, were the chief. The Emperor Theodosius suppressed the festival. Nothing certain is known respecting the doctrines revealed to the initiated, but they are supposed to have contained comforting assurances with regard to a future state. Distinctions of class were abolished at the Eleusinia, and with this view Lycurgus forbade any woman to ride in the procession in a chariot, under penalty of a heavy fine. See Hermann, *Lehrbuch der gottesdienstlichen Altertümer der Griechen*; Förster, *Der Raut und die Rückkehr der Persephone*; Haggenmacher, *Die Eleusinischen Mysterien*; Grote, *History of Greece*, part i., chap. i.

Eleu'sis (in Gr. Ἐλευσίς, or Ἐλευσίν): an ancient and celebrated city of Greece; situated in Attica, near the northern shore of the Gulf of Salamis; about 12 miles N. W. of Athens. It was the chief seat of the worship of Demeter (Ceres), who had here a large temple, and whose mystic rites, called ELEUSINIA (*q. v.*), were performed annually with great pomp. The site of Eleusis was near the modern village of Levsina. See Wordsworth, *Greece* (1853).

Eleu'thera: one of the BAHAMA ISLANDS (*q. v.*).

Eleuthe'ria [from Gr. ἐλεύθερος, free]: a national festival of the ancient Greeks, instituted in 479 B. C. to commemorate their deliverance from the Persian armies which had invaded Greece. It was celebrated annually at Platæa in the early part of autumn.

Elevation [from Lat. *eleva'tio*; *ē*, out + *leva're*, lighten, raise]: the act of raising to a higher level or place; the act of exalting in rank; altitude; height above the surface; sometimes exaltation of mind or style; a hill or elevated ground. In engineering and architecture, a geometrical representation of a building or other object, as if projected (see GEOMETRY, DESCRIPTIVE) upon a vertical plane by perpendicular lines drawn through its defining lines or points. It is generally a projection of the exterior, therein differing from a *section* which shows the interior, or a part, as if cut through.

ELEVATION in astronomy is the angular height or the altitude of a celestial object above the horizon, measured by the arc of a vertical circle passing through it and the zenith. Thus the elevation of the pole denotes the arc of the meridian intercepted between the pole and the horizon, and is always equal to the latitude of the observer. The greatest elevation of a star occurs when that star is on the meridian.

ELEVATION in gunnery is the inclination of the axis of the cannon or gun above the object aimed at, in order to counteract the effect which the force of gravity causes. It varies with the range.

Elevation of the Host (in Lat. *eleva'tio hos'tiæ*): in the Roman Catholic ritual of the mass, the lifting up of the elements after consecration for the adoration of the people. It forms one of the most solemn and impressive features of the whole Roman Catholic liturgy.

Elevators, or **Lifts**: machines for lifting passengers or freight, consisting essentially of a car which is raised by ropes or is pushed up by a ram from below, power being applied to the ropes or ram, the car being maintained in lateral position by rails of wood or metal, upon which it moves. The term is usually applied to machines of which the vehicles move in a vertical direction. Elevators of crude form have been known and used since the earliest times, being propelled by man, animal, and water power, but have been applied extensively to buildings only since about the year 1850.

Elevators are classified as hand, power or belt, steam, hydraulic, and electric elevators. *Hand elevators*, as the name implies, are worked by hand-power. *Power elevators* are those in which the ropes supporting the car are wound upon drums, revolved by gearing and pulleys driven by belts, and are applied to factories where power is distributed by shafting. *Steam elevators* are those in which the ropes are wound on drums revolved by steam-engines, the engines forming part of the machine, and are used principally in mines, blast furnaces, and warehouses.

Hydraulic elevators are of two principal forms, the ram type much used in Europe, and the suspended type. The ram elevator, which was first used extensively by M. Léon Edoux, of Paris, France, consists of a cylinder, usually sunk in the earth, containing a ram, on top of which is placed the cage. When water pressure is admitted to the cylinder, the ram is forced upward, pushing the car above it; when the pressure is relieved, the car and plunger descend by their own weight. In the suspended type the cables are carried over sheaves at the top of the building, and thence down and around alternately fixed and movable sheaves, the movable sheaves being attached by rods to a piston moving in the cylinder, the arrangement being simply the reverse of a tackle. When water-pressure is admitted to the cylinder, the fixed and movable sheaves are forced apart, taking up on the cables and lifting the car. When the pressure is relieved, the car descends by its unbalanced weight, drawing the sheaves together. The cylinder is usually placed in a vertical position, but is sometimes placed horizontally. In towns possessing high-pressure water-service, the cylinders are connected directly with the water-mains, the water being discharged after use into the sewers. In some instances elevators are operated directly from artesian wells. In towns where the city water-pressure is insufficient, pressure is obtained by pumping water into storage tanks on top of the building; and where the height is insufficient, additional head is obtained by using closed tanks partially filled with compressed air. Where water is specially pumped, it may be used over again indefinitely, the only loss being by leakage and evaporation. *Electric elevators* are essentially the same in construction as steam elevators, electric motors being substituted for the engines and winding the cables on drums in the same manner.

The movement of an elevator is controlled from the car by means of an operating rope connecting with the motive machinery, the control being effected in power elevators by a belt shifter, and in steam and hydraulic by a valve which reverses the direction of the steam or water, or cuts them off entirely. In electric elevators the current is reversed or cut off by a switch. The operating rope is usually moved directly by hand, but is sometimes moved indirectly through the medium of a lever or hand wheel.

Safety devices are applied to elevators to prevent overrunning the limits of travel, falling in case of rupture of the cables, or descending at dangerous speed.

Overrunning is prevented by stop balls on the operating rope, which are operated by the car itself in the event of neglect of the conductor. The winding drums of steam and electric elevators, and the pistons of hydraulic elevators, also automatically close the operating valve when the proper length of travel has been completed. Falling is prevented by grips which act upon the strips guiding the car, and which are thrown into action by springs or levers, actuated by the breaking of one or more of the cables. Descending at dangerous speed is prevented by ball governors, placed at top of the shaft or on the car, so adjusted as to operate the safety-grips whenever the car attains an undue velocity. A great variety of safety-grips are in use; those most employed consist of wedges which squeeze the guide strips, or toothed dogs which cut into the strips, the guide strips being made of wood.

Among the most notable elevators are the steam elevator in the Washington monument, at Washington, D. C., which has a travel of 500 feet; the hydraulic elevators in the Eiffel Tower, having a travel of 420 feet, and lifting 50 persons at a speed of 400 feet per minute; and the three Otis hydraulic elevators in the terminal station of the North Hudson County Railway Company, at Weehawken, N. J., having a travel of 148 feet each, capable of lifting 140 persons at a speed of 300 feet per minute.

THOMAS E. BROWN, Jr.

Elf: [O. Eng. *ælf* : Germ. *Alp*, ghost, sprite; cf. *Alpdrücken*, nightmare; the word is probably closely connected with the Skr. *ṛbhú-*, a name applied to three deities or genii of artistic handiwork in Vedic mythology]: one of a class of imaginary beings who figured prominently in the mythology of Northwestern Europe, Germany in particular; as good or bad elves their exploits gave rise to a great number of marvelous tales. Fairies take the place of elves in Celtic legends, and are in general represented as beneficent.

Elgin, ĕl'gin: a royal burgh of Scotland; capital of County Moray or Elginshire; on the river Lossie; 5 miles from the sea and 118 miles N. of Edinburgh, with which it is connected by a railway (see map of Scotland, ref. 6–H). It is beautifully situated in a fertile valley, and has ten churches, a hospital, and an institution for the education of orphans, endowed with £70,000 by Gen. Andrew Anderson. Elgin has the ruins of a cathedral founded in 1224, the most extensive and beautiful of ancient Scottish remains; also the ruins of a castle which was the residence of the Earls of Moray. Pop. (1891) 7,799.

Elgin, ĕl'jin: city and railway center; Kane co., Ill. (for location of county, see map of Illinois, ref. 2–F); situated on Fox river, and on the Ch., Mil. and St. P., Ch. and N. W., and E., J. and E. railways; 36 miles W. by N. from Chicago. It has an excellent academy, fine schools, the Northern Insane Asylum, which cost $750,000, great water-power, and more than forty manufacturing concerns; among them the National watch-factory, one of the largest in the world, employing 3,200 skilled operators, and large milk-condensing factories. Elgin is also one of the great dairy centers of the U. S. Pop. (1880) 8,787; (1890) 17,823; (1900) 22,433.

EDITOR OF "COURIER."

Elgin, ĕl'gin, JAMES BRUCE, Eighth Earl of: statesman; b. in London, July 20, 1811; educated at Oxford; in 1841 succeeded his father, Thomas Bruce, in the earldom, which was a Scottish peerage, and did not admit him into the House of Lords. As governor of Jamaica he improved the condition of the Negroes who had been emancipated during the administration of his predecessor, Lord Metcalfe, at the same time earning the respect and confidence of the planters. His administration of the office of Governor-General of Canada, to which he was appointed in 1846, was even more successful. He followed the policy marked out by his uncle, Lord Durham, the friend of Canadian self-government, holding the position of a mediator between parties governed in accordance with constitutional principles. He was created a peer of the United Kingdom in 1849, and in 1854 was offered a seat in the cabinet as Chancellor of the Duchy of Lancaster, which he declined. He was sent on a mission to China in 1857, and negotiated the treaty of Tientsin (1858), guaranteeing protection to Christians, permitting the residence of foreign ambassadors, opening the country to travelers with passports, and granting important commercial privileges. He afterward went to Japan, where he negotiated the treaty of Yedo. In 1859 he was Postmaster-General, and in 1861 was appointed Governor-General of India, where his administration was marked by a faithful adherence to Canning's policy in conciliating the feudatories of the British Government. D. at Dhurmsala, India, Nov. 20, 1863, and was succeeded in the earldom by his son Victor Alexander Bruce (b. 1849), who was appointed Viceroy of India in Oct., 1893. See Walrond, *Letters and Journals of Lord Elgin* (1872), and *The Friend of India* (1862–63).

Elgin, THOMAS BRUCE, Seventh Earl of: diplomat; b. in Scotland, July 20, 1766. He obtained the rank of general in the army, and was sent as envoy extraordinary to Berlin in 1795. In 1799 he was appointed ambassador to Constantinople. He expended a large sum of money (about £74,000) in the removal of statues, bas-reliefs, and other remains of ancient art from the Parthenon and Acropolis of Athens to England. See ELGIN MARBLES. D. Nov. 14, 1841.

Elgin Marbles: a collection of Greek sculptures in the British Museum, London. These were taken to England from Greece by Thomas Bruce, seventh Earl of Elgin, who was British ambassador at Constantinople from 1799 to 1803. He obtained a firman from the Turkish Government allowing him to put up scaffolding around the Parthenon at Athens, to make casts and drawings, and even to remove sculptured or inscribed stones. Under this permit he stripped the Parthenon of many of the metopes of the outer frieze (that of the entablature), all the pediment sculptures that were in fair condition, and the greater part of the cella frieze in low relief. The temple had been shattered by an explosion a century before (see ACROPOLIS and PARTHENON), but the two ends were comparatively little injured until Lord Elgin's workmen wrenched the blocks of marble apart. The result is that the building is now almost entirely in ruins, and while a few slabs of the inner frieze and a number of the metopes remain in the building, all the pediment-sculptures, the best of the metopes, and by far the larger part of the cella frieze form part of the Elgin marbles.

The Elgin marbles were partly exhibited in London by their owner, and were purchased by the nation in 1816 at a price less than half as great as their cost to him. They are arranged in the Elgin room in the British Museum. The slabs of the cella frieze are let into the wall and covered with glass to preserve them from the injurious effects of the London atmosphere. The statues and groups from the pediments are arranged on tables. Fifteen metopes are let into one of the walls, casts of others are shown, but no more of the originals are in the collection.

A full account of the removal, transportation, and purchase is to be found in Michaelis's *Ancient Marbles in Great Britain*, Ellis's *Elgin Marbles*, and Edwards's *Lives of the Founders of the British Museum*. The more important sculptures are described and figured in Michaelis's *Der Parthenon*, and many of them also in works on Greek sculpture, for which see SCULPTURE. RUSSELL STURGIS.

Elginshire, called also **Moray**: a county of Scotland; bounded N. by the German Ocean, E. by Banffshire, S. by Inverness, and W. by Nairn. Area, 482 sq. miles. The climate is mild and dry, and the soil open, sandy, and gravelly; very fertile in the northern part. The chief agricultural products are wheat, oats, and other kinds of grain; the county was formerly called the granary of Scotland. The chief articles of export are cattle, salmon, grain, and timber. Together with Nairnshire, it sends one member to Parliament. Chief town, Elgin. Pop. (1901) 44,757.

Elgon, Mt.: See the Appendix.

Eli (Sept. 'Ηλί): high priest at the temple of Shiloh when the ark of the covenant was in the tabernacle at that place (1 Sam. i. 3, 9), and civil judge of Israel for at least twenty years. In his old age his sons, Hophni and Phinehas, whom he had invested with authority, profaned the sanctuary and received from him only a feeble rebuke. In consequence judgments were pronounced against his house by Samuel, who, as a child, had ministered to the Lord before Eli. Several years after this Israel was defeated in battle by the Philistines, Hophni and Phinehas were slain, and the ark of God, which they had taken to the field, was captured (1 Sam. iv.). A messenger from the army brought the fatal news to the aged high priest, who, on hearing that the ark was taken, fell from his seat and died.

Elia: See LAMB, CHARLES.

Elias, *ā*-lee'ăăs, DOMINGO: Peruvian statesman; b. in Ica, 1805; educated in Europe. He was a prominent agriculturist and statesman, acting president for a short time in 1844, and was otherwise prominent in Peruvian politics. D. at Lima in 1867.

Eli'as Levi'ta: a Jewish rabbi; b. at Neustadt, near Nuremberg, Feb. 8, 1472. He taught Hebrew at Rome and Venice, was distinguished as a grammarian, and published numerous works, among which are a *Hebrew Grammar*, a *Chaldaic, Talmudic, and Rabbinical Lexicon*, and *Massorah*, containing critical notes on the text of the Bible. Among his pupils were Sebastian Münster (who translated several of his works into Latin), Fr. Buxtorf, Cardinal Egidio, of Viterbo (in whose house he lived for many years, and whom he aided in unraveling the enigmas of the Cabala), Dr. Eck, and others. He was neither a deep nor an original spirit, but he was learned and sound. He remained a Jew, although so much with Christians. He first popularized the views that the canon of the Old Testament was formed by Ezra and the great synagogue, and in the face of the current Jewish theory denied that the Hebrew vowel-points were earlier than the Talmudists. D. in Venice in 1549.

Élie de Beaumont, *ā*'lee'de-bō'mōṅ', JEAN BAPTISTE ARMAND LOUIS LÉONCE: geologist; b. at Canon, Calvados, France, Sept. 25, 1798. He was educated in the Polytechnic School, and became Professor of Geology in the College of France in 1832, chief engineer of mines in 1833, and a member of the Institute in 1835. Among his works are *Carte géologique de la France* (2d ed. 1855), and *Notices sur les systèmes des montagnes* (1852), in which he gave his theories on the elevation of mountain-ranges. He succeeded Arago as perpetual secretary of the Academy of Sciences in 1853. D. in Canon, Sept. 21, 1874.

Elijah [Heb. *'Elijahu*, for whom Jehovah is God; Gr. 'Ηλίας]: a Hebrew prophet concerning whose ancestry the Scriptures are silent. The chief events in his life, as related in the first and second books of Kings, were his prediction of the great drouth which afflicted Israel; the confounding and destruction of the priests of Baal; his persecution by Jezebel; his prediction of the violent deaths of Ahab, Jezebel, and their son Ahaziah; his appointment of Elisha to succeed him in the prophetic office; and his own translation in a chariot of fire.

E'lim [Heb., stout trees]: the second station mentioned in the march of the Israelites after crossing the Red Sea (Ex. xv. 27). It has been identified with Ghurundel, about halfway between Suez and Sinai.

Elio, ā'lēĕ-ō, FRANCISCO JAVIER: general; b. at Pamplona, Spain, Mar. 4, 1767; entered the army in 1785. In 1805 he was sent to the Rio de la Plata with re-enforcements against the English; was appointed commandant-general of the Banda Oriental; forced the English to give up Montevideo (Sept. 9, 1807), and was made governor of that city; returned to Spain in 1810, and was appointed viceroy of Buenos Ayres; but he was opposed by the junta and people. (For events of the period, see URUGUAY.) Gen. Elio returned to Spain in 1811, and as commander of the Spanish troops in Catalonia and Valencia won brilliant victories over the French in 1812–13. He was made governor and captain-general of Murcia and Valencia soon after the restoration of Ferdinand VII.; in 1820 he was imprisoned by the revolutionists; accused of instigating an armed attempt to liberate himself, he was condemned by a court martial, and executed at Valencia, Sept. 4, 1822.

HERBERT H. SMITH.

Eliot, ANDREW, D. D.: b. in Boston, Mass., Dec. 28, 1718; a descendant of Andrew Elliott, of Somersetshire, England, who settled at Beverly, Mass., about 1683. He graduated at Harvard in 1737, and became associate pastor of the New North church, Boston, Mass., in 1742, and sole pastor in 1750. He took an active interest in the conversion of the Indians, and in defending the Congregational polity against the attacks of the Episcopalians. In 1773 he declined an election to the presidency of Harvard College. D. in Boston, Sept. 13, 1778.

Eliot, CHARLES WILLIAM, LL. D.: president of Harvard University; b. in Boston, Mass., Mar. 20, 1834; educated at Boston Public Latin School; A. B., Harvard, 1853; tutor in mathematics at Harvard 1854–58; assistant Professor of Mathematics and Chemistry 1858–61; of Chemistry 1861–63; Professor of Chemistry in the Massachusetts Institute of Technology 1865–69; president of Harvard since 1869; author (with F. H. Storer) of *Manual of Inorganic Chemistry* (1866); *Manual of Qualitative Chemical Analysis* (1869). President Eliot's chief writings since his election to the presidency of Harvard have been his annual reports; these have ranked among the most valuable contributions to the literature of higher education. His influence has been widely felt, and has strongly promoted progress in university methods and management. C. H. T.

Eliot, GEORGE: *pseudonym* of Mary Ann (or Marian) Evans, an English novelist: b. at Arbury farm, in Warwickshire, England, Nov. 22, 1819. She remained under the parental roof, first at Griff, on the same estate, afterward at Coventry, until 1849. Her father, a man of considerable business ability, was agent of the estate on which Arbury farm was situated, and afterward also of Lord Aylesford, Lord Lifford, and others. His children were well educated and strictly trained, but Mary Ann very early exhibited great independence of character, and in 1841 abandoned the beliefs in which she had been reared, choosing a spiritual path of her own. In 1846 she published anonymously a translation of Strauss's *Life of Jesus*, which in 1854 was followed by a translation of Feuerbach's *Essence of Christianity*. After the death of her father, in 1849, she resided for one year at Geneva, and then settled in London as assistant editor of the *Westminster Review*, to which she contributed a great number of remarkable articles. She enjoyed the intimate friendship of all the most advanced thinkers of her day, and in 1854 she formed a union with GEORGE HENRY LEWES (*q. v.*), which was somewhat embarrassing, as Mr. Lewes, who had separated from Mrs. Lewes, but was not divorced from her, was unable to make Miss Evans his lawful wife. Otherwise the union was a happy one, and it was Mr. Lewes who first gave her the idea of attempting a work of fiction. In 1858 *Scenes of Clerical Life* appeared, and was immediately recognized as the product of a great and original power. It was followed by *Adam Bede* (1859), which was a still greater success, and by *The Mill on the Floss* (1860); *Silas Marner* (1861); *Romola* (1863); *Felix Holt* (1866); *Middlemarch* (1871–72); *Daniel Deronda* (1878); *The Impressions of Theophrastus Such* (1879). She published, also, a drama, *The Spanish Gypsy* (1868), and the poems *Agatha*, *The Legend of Jubal*, and *Armgart* (1869). After the death of Mr. Lewes, in 1878, she married John Walter Cross, who published an elaborate and very interesting biography of her, *George Eliot's Life as Related in her Letters and Journals* (1885–86). She died at Cheyne Walk, Chelsea, Dec. 22, 1880.

Eliot, JOHN: "the apostle to the Indians"; b. in England; baptized at Widford, Hertfordshire, Aug. 5, 1604. He was educated at Cambridge, removed to Boston, Mass., in 1631, and in 1632 began his connection with the church at Roxbury which he held at his death. He acquired the language of the Indians, and from 1646 he devoted himself to improving their condition and converting them to Christianity. He traveled extensively among them, enduring great privations and passing through many dangers. He succeeded in acquiring great influence over them, and many of them embraced the Christian faith. He translated the Bible into the Indian tongue (1661–63), published an Indian grammar (1666), and a number of other works, mostly relating to his missionary labors. D. in Roxbury, Mass., May 21, 1690. See his *Life* by Convers Francis (Boston, 1836).

Eliot, Sir John: statesman; b. at Port Eliot, Cornwall, England, Apr. 20, 1592; traveled abroad in his youth and met Villiers, afterward Duke of Buckingham, whose friendship and patronage procured his official advancement. Entering the Parliament of 1624 the devoted adherent of the duke, he supported with zeal his warlike policy toward Spain, but being a staunch upholder of parliamentary privilege against royal encroachment he was soon driven into opposition by the duke's haughty assertion of the king's prerogatives and became as bitter in his antagonism as he had been zealous in his partisanship. He pressed with force and ability the proceedings that ended in Buckingham's impeachment, and at the trial (1626) he displayed his exceptional gifts as an orator in a masterly speech, denouncing the minister. For this he was imprisoned in the Tower (May 11–19).

For the next few years Eliot was the central figure of the opposition to arbitrary government, and the persistent advocate of the principle of ministerial responsibility. Too radical for the other leaders, who deprecated the passion that he showed, he nevertheless found them following his policy in the end. In the Parliament of 1628 he denounced the king's arbitrary taxation, and was instrumental in carrying through the famous petition of right. In 1629, when the king ordered the House to adjourn and the indignation of the members broke out in a scene of wild disorder, it was Eliot who held the Speaker in his chair, while with locked doors and amid noisy summoning from without the Commons passed his resolutions vindicating parliamentary rights. "None have gone about to break parliaments," said he on this occasion, "but in the end parliaments have broken them." Eliot's boldness again cost him his liberty. With eight others he was thrown into the Tower (Mar. 4, 1629), and his steadfast refusal to acknowledge himself in the wrong caused his detention there till his death, Nov. 27, 1632. Among his writings are *The Monarchy of Man* (1879); *An Apology for Socrates* (1881); and *Negotium Posterorum* (1881). F. M. Colby.

Eliot, Samuel, LL. D.: historian; b. in Boston, Mass., Dec. 22, 1821; graduated at Harvard in 1839. Having visited Rome and traveled in Europe, he projected a *History of Liberty*, a part of which he published in 1849, two volumes, entitled *The Liberty of Rome*. *The Early Christians* (2 vols., 1858) is the second part of the same work. Among his other writings is a *Manual of United States History from 1492 to 1850* (1856). He was president of Trinity College, Hartford, in 1860–64; lecturer at Harvard College 1870–73; superintendent of Boston public schools 1878–80; became a member of the Boston school committee in 1885; and was connected with various charitable institutions. D. Sept. 14, 1898.

E'lis (in Gr. Ἦλις; Fr. *Élide*): a small state of ancient Greece in the northwestern part of the Peloponnesus; bounded N. by Achaia, E. by Arcadia, S. by Messenia, and W. by the Ionian Sea. It is intersected by the rivers Alpheus (now Rouphia) and Peneus (Gastuni). The surface is diversified by hills and fertile plains and valleys. Elis was divided into three districts—Hollow Elis, Pisatis, and Triphylia. The chief towns were Elis, Cyllene, Pylos, and Olympia. The Olympic games, the greatest national festival of the Greeks, were celebrated at Olympia. Elis forms with Achaia a nomarchy of the modern kingdom of Greece; area, 1,901 sq. miles; pop. (1896) 236,251.

Elis: city of ancient Greece; the capital of the state of the same name; situated on the river Peneus, about 10 miles from its mouth. It is mentioned as a town of the Epeii by Homer (*Iliad*, ii.). Its acropolis was on a hill nearly 500 feet high. The city contained several fine temples, a theater, and the largest gymnasium in Greece. All the athletes who contended at the Olympic games were required to undergo one month's previous training in this gymnasium. When Pausanias visited Elis (about 175 A. D.) it was one of the most splendid and populous cities of Greece. The site is occupied by the modern Paléopoli or Kaloscopi.

Elisæ'us (in Armenian *Egishe*): Armenian historian and theologian of the fifth century; educated by Sahab and Mesrob; entered the service of the Armenian prince Vartan, and was his private secretary during the rebellion against the Persians; was afterward elected bishop of the Amadunians, and was present at the great national synod of Ardashad in 450. His principal work is a history of the Persian persecution, when Yzdegerd II. actually attempted to extinguish Christianity in Armenia, *The History of Vartan and the Battle of the Armenians*. He narrates these events as an eyewitness, and all official sources of information were at his disposal. The book was first printed in Constantinople (1764); the best edition of it is that of Venice (1852). It was translated into English by C. F. Neumann (London, 1830). Elisæus also wrote commentaries on various books of the Old Testament, sermons, etc., of which a collected edition appeared in Venice (1838). D. in 480.

Eli'sha: a Hebrew prophet, called to the prophetic office by Elijah, receiving his mantle when he was taken up into heaven; was recognized by the other prophets as their spiritual head, and enjoyed great respect from the people of Israel throughout his whole life. His history is told in the second book of Kings, and his death is commonly fixed at 840 B. C.

Eli'sors [O. Fr. *elisour*, deriv. of *elire* (Mod. Fr. *élire*) < Lat. *eli'gere*, choose]: in law, persons (two in number) named by the court to return a jury when the sheriff and coroners are incompetent. Against their return no challenge can be taken to the array of jurors, though there may be a challenge to individual jurors or to the polls.

Elizabeth: city and railway center; capital of Union co., N. J. (for location, see map of New Jersey, ref. 3–D); situated on Staten Island Sound and on Elizabeth river, 14 miles from New York. It has many churches, among them one which cost $500,000 (R. C.), an orphan asylum, an extensive establishment for making sewing-machines, ship-yards, pump-factory, oil-refineries, a large brick-yard, several foundries, etc. The census of the U. S. for 1890 shows 187 manufacturing establishments, with a capital of $7,770,703, giving employment to 6,532 persons, at an annual wage of $3,703,-731. The cost of materials was $4,490,353; the value of product $10,446,864. Elizabeth contains the residences of many New York business men, has several parks, and is surrounded by a rich farming country. Elizabethtown, as it was originally called, was settled in 1665, and was the capital of New Jersey until 1790. Pop. (1880) 28,229; (1890) 37,764; (1900) 52,130. Editor of "Leader."

Elizabeth: borough; Allegheny co., Pa. (for location of county, see map of Pennsylvania, ref. 5–B); situated on railway and on the Monongahela river, 22 miles S. E. of Pittsburg. It is an important shipping-point for coal, and is also engaged in boat-building and agriculture. Pop. (1880) 1,810; (1890) 1,804; (1900) 1,866.

Elizabeth: Queen of England, and the last sovereign of the house of Tudor; b. at Greenwich, Sept. 7, 1533. She was a daughter of Henry VIII. and Anne Boleyn. Her childhood was passed in comparative retirement, and she was educated by persons who favored the Reformed religion. She learned the Latin, Greek, French, and Italian languages of the famous Roger Ascham. In 1554 she was confined in the Tower by order of Queen Mary, who believed her to be implicated in Wyatt's rebellion, and regarded her with jealousy because she was the favorite of the Protestant party. Elizabeth narrowly escaped death, for some of the bishops and courtiers advised Mary to order her execution. After she had passed several months in the Tower, she was removed to Woodstock, and appeased Mary by professing to be a Roman Catholic.

On the death of Queen Mary (Nov. 17, 1558) Elizabeth ascended the throne, and the majority of the people rejoiced at her accession. She appointed William Cecil Secretary of State, and Nicholas Bacon keeper of the great seal. She retained several Roman Catholics in her privy council, but she refused to hear mass in the royal chapel. The Protestants were the majority in the Parliament which met in 1559, abolished the mass, adopted the Thirty-nine Articles as the religion of the state, and recognized the queen as the head of the Church. She declined an offer of marriage made to her by Philip II. of Spain. Her foreign policy was pacific. She waged no war for conquest, but to promote the stability of her throne she aided the Protestant insurgents in Scotland, France, and the Netherlands with money and troops. In 1563 the Parliament, anxious that she should have an heir, entreated her to marry, but she returned an evasive answer, and would neither accept the hand of any of her suitors nor decide in favor of any claimant of the throne. Among her suitors were the French Duke of Anjou, the Archduke Charles of Austria, and Robert Dudley, Earl of Leicester, who was for many years her chief favorite. William Cecil, Lord Burleigh, was her Prime Minister and most trusted adviser during the greater part of her reign, the prosperity of which was largely due to his prudence and influence.

Mary Queen of Scots, fleeing from her rebellious subjects, took refuge in England in 1568, and was detained as a prisoner by Elizabeth. The latter regarded Mary as a dangerous rival, because the English Catholics wished to raise her to the throne of England, and formed several plots and conspiracies for that object. (See MARY STUART.) Mary was beheaded Feb. 8, 1587. Philip II. of Spain had long meditated a hostile enterprise against Queen Elizabeth, who had offended him by aiding his revolted Dutch subjects and by persecuting the English Catholics. For the invasion of England he fitted out the Invincible Armada, which consisted of about 130 vessels, with over 19,000 soldiers, and sailed in May, 1588. A violent storm dispersed the Spanish ships, many of which were wrecked, and the rest were encountered by the English fleet, mostly consisting of small but excellently equipped vessels, under Admiral Howard, and thoroughly beaten, Aug. 8, 1588. The disastrous failure of this expedition did not terminate hostilities between England and Spain. An English fleet took Cadiz in 1596. After the Earl of Leicester died (1588) the Earl of Essex was the queen's favorite courtier. The Puritans were severely persecuted in the latter part of her reign. She died Mar. 24, 1603, and was succeeded by James VI. of Scotland, who became James I. of England. Her reign was one of the most prosperous and glorious in English history. The Elizabethan age was almost unequaled in literature, and was illustrated by the genius of Shakspeare, Spenser, Bacon, Sidney, and Raleigh.

AUTHORITIES.—Froude, *History of England* (vols. vii. to xii.); Green, *History of the English People*; Camden, *History of Queen Elizabeth* (1625); Dr. Thomas Birch, *Memoirs of the Reign of Queen Elizabeth* (1754); also Motley, *The Rise of the Dutch Republic* and *History of the United Netherlands.* Revised by C. K. ADAMS.

Elizabeth, SAINT, of Hungary: a daughter of Andrew II., King of Hungary; b. at Presburg in 1207. She became in 1221 the wife of Louis, landgrave of Thuringia, who died in 1227 at Otranto, on a crusade to the Holy Land. His eldest brother Henry seized his possessions, and banished his widow and children. The knights of Thuringia restored her son Herman to the throne, and Elizabeth received as a dower the city of Marburg, where she retired with her daughters, and spent the remainder of her life in what became one continued penance. D. Nov. 19, 1231. Says Mrs. Jameson, "Of all the glorified—victims must I call them, or martyrs?—of that terrible but poetical fanaticism of the thirteenth century, she was one of the most remarkable; and of the sacred legends of the Middle Ages hers is one of the most interesting and most instructive." See Charles de Montalembert, *Vie de S. Elizabeth de Hongrie* (1836), which has been translated into English; also Charles Kingsley's *Saint's Tragedy*.

Eliz'abethan Architecture: a term applied to the style which prevailed in England after the decline of the Gothic, mainly during the reigns of Elizabeth and James I. It resulted from the introduction of Renaissance or classic forms from Germany and Holland during the reigns of Henry VIII. and Elizabeth; and, while it retained the mullioned and traceried windows and bays, the hood-mouldings and parapets of the preceding Tudor style, it employed many classic details and a somewhat monotonous style of surface-carving derived from Holland and Germany. It appears chiefly in domestic architecture, and was succeeded by the Jacobean, in which the Gothic details wholly disappeared.
A. D. F. HAMLIN.

Elizabeth, Cape: See CAPE ELIZABETH.

Elizabeth City: town; capital of Pasquotank co., N. C. (for location of county, see map of North Carolina, ref. 2–J); situated on railway and on the Pasquotank river, 46 miles S. of Norfolk, Va. It is the center of an agricultural district producing chiefly grain and cotton, and has Creecy Park, a State normal school, steam grist-mills and saw-mills, a cotton-factory, shingle-factories, and planing-mill; also a fine harbor, safe and sufficiently deep for large vessels. Pop. (1880) 2,315; (1890) 3,251; (1900) 6,348.
EDITOR "ECONOMIST AND FALCON."

Elizabethgrad, or **Jelissawetgrad**: town of Russia; government of Kherson; 160 miles N. E. of Odessa (see map of Russia, ref. 9–C). It has an important trade and is a great market for horses. Pop. (1897) 61,841.

Elizabethine Nuns: a congregation of monastic women in the Roman Catholic Church, belonging to the third order of St. Francis. The name Elizabethines was at first applied to voluntary associations of women who imitated the zeal of St. Elizabeth of Hungary, without taking monastic vows or retiring from the world. But from the tradition that St. Elizabeth belonged to the third order of St. Francis, the name is sometimes given to Franciscan nuns. It is probable, however, that the Franciscan nuns of the third order were not established till 1395.

Elizabeth Islands: a group of sixteen small islands belonging to Dukes co., Mass., lying between Vineyard Sound and Buzzard's Bay. Since 1864 they have constituted the township of Gosnold. The largest of the islands in the order of their size are Naushon, Nashawena, Pasque, Cuttyhunk, Nonamesset, Uncatena, and Penikese. Cuttyhunk was the seat of Bartholomew Gosnold's first colony in "Virginia," founded in 1602, but abandoned the same year on account of troubles of the colonists with each other and with the Indians. The islands are a favorite resort for fishing and yachting, and were formerly much more thickly inhabited. Pop. (1880) 152; (1890) 135; (1900) 164.

Elizabeth Petrov'na: Empress of Russia; b. in Dec. 1709; daughter of Peter the Great and Catherine I. She was dissolute in morals, and appears to have been unambitious, as she made little effort to obtain the throne. Ivan, an infant, was proclaimed emperor in 1740, but the French surgeon Lestocq and other partisans of Elizabeth conspired against Ivan with success, and she became empress in 1741. As an ally of Austria and France she waged war against Frederick the Great in the Seven Years' war. Her army gained a victory at Kunersdorf, and entered Berlin in 1760. She had several children by Count Rasumovski, who was first her servant, subsequently her chamberlain, and was at length secretly married to her. D. Jan. 5, 1762, and was succeeded by her nephew, Peter III.

Elizabeth Stuart: Queen of Bohemia; daughter of James I. of England; b. in the palace of Falkland, Scotland, Aug. 19, 1596. She was married in 1613 to Frederick V., elector palatine, who was chosen King of Bohemia in 1619 by the Protestant party. She is said to have been beautiful, and is considered a heroine. Her husband was defeated in battle in 1620, and she passed the remainder of her life in exile and adversity. She was the mother of thirteen children, including the famous Prince Rupert. D. in England, Feb. 13, 1662. George I. of England was her grandson. See her *Life* in Mrs. Everett Green's *Lives of the Princesses of England* (1851).

Elizabeth'pol, or **Jelissawetpol'**: a government of Transcaucasia, Asiatic Russia; bounded N. by Tiflis, E. by Baku, S. by Persia, and W. by Erivan; area, 17,038 sq. miles. The government consists in the west of high mountains, while the east is more level. It is drained by the Kur and numerous other small streams. Chief town, Elizabethpol. Pop. (1897) 888,954.

Elizabethpol: city; capital of the government of the same name; 90 miles S. E. of Tiflis (see map of Russia, ref. 12–G). It has a number of churches, mosques, and fruit-gardens. Silkworms are raised here. Pop. (1897) 33,022.

Elizabethtown: city and railway junction; capital of Hardin co., Ky. (for location of county, see map of Kentucky, ref. 3–F); 42 miles S. by W. from Louisville. It has various manufactures, and is an agricultural center. Pop. (1880) 2,526; (1890) 2,260; (1900) 1,861.

Elizabethtown: borough; Lancaster co., Pa. (for location of county, see map of Pennsylvania, ref. 6–H); situated on railway, 18 miles W. N. W. of Lancaster and 18 miles E. S. E. of Harrisburg. It has a farming-implement manufactory, a machine-shop, and a flouring-mill. Pop. (1880) 980; (1890) 1,218; (1900) 1,473.

Elk [O. Eng. *elch*, *eolh*, though $k < ch$ remains unexplained: M. H. Germ. *elch* < O. H. Germ. *elaho*; the word has been displaced in Mod. Germ. by *Elen*, *Elenthier*, a Baltic loan-word, cf. Lith. *élnis*]: the popular name of a species of deer (*Alces machlis*) found in the northern parts of Europe, Asia, and North America. It is one of the largest animals of the deer family or *Cervidæ*, is about 6 feet high, and

Elk or moose.

sometimes weighs 1,200 lb. It has a short, compact body raised on long stilt-like legs, a short, thick neck, and a large, narrow head nearly 2 feet long. The neck is covered with a short thick mane. The antlers of the full-grown elk are flattened, displaying a broad blade with numerous snags on each horn. The tail is only 4 or 5 inches long. The color of its hair is brownish black. Elks can run with great speed. They frequent marshy districts and swampy forests, feeding on lichens, leaves, and branches of trees. Their flesh is esteemed for food.

The true American elk, commonly called the moose, is found from Maine westward to British Columbia. It is much hunted for its flesh and skin in winter, when the frozen crust of the snow, not strong enough to bear the animal's weight, seriously impedes its progress, its great speed at other times making its capture difficult. When brought to bay, a blow with its fore foot or horns is a serious matter for the huntsman. It is the largest known animal of the deer family now existing.

The beast generally known in North America as the elk is the wapiti (*Cervus canadensis*), an animal nearly as large as the moose, once found as far east as Pennsylvania but now restricted to the northwest. It goes in large herds, and is hunted for its flesh, and especially for its skin, which is highly prized. Several other large species of deer (as in Ceylon) or of antelope (as in South Africa) are known locally as elks. The true elks have a broad hairy muzzle, with a bald spot between the nostrils, horns large and palmated, with no basal snag; true deer have a basal snag, and more or less rounded horns; the muzzle is bare and moist. See DEER. Revised by F. A. LUCAS.

El Khargeh, el-kaar'ge: a town of Upper Egypt, capital of the Great Oasis; lat. 25° 28′ N., lon. 30° 40′ E. Here are ruins, chiefly Macedonian and Roman, including a temple, and an ancient necropolis. El Khargeh is also the name of the Great Oasis itself, which is 80 miles long and 10 miles broad, and was anciently still larger. It abounds in acacia and doum-palm trees, and has warm and cold springs and a stream of water; rice is here cultivated. See OASES, LIBYAN.

Elkhart: city and railway center; Elkhart co., Ind. (for location of county, see map of Indiana, ref. 2–E); situated at the confluence of the St. Joseph and Elkhart rivers, 100 miles E. of Chicago. It has fine churches and schools, locomotive repair-shops of the L. S. and M. S. Railway, carriage-factories, paper-mills, starch-mills, manufactories of printing-presses and musical instruments, water-works, electric lights, electric street railway, etc. It is chiefly a manufacturing town, and has several building and loan associations. Pop. (1880) 6,953; (1890) 11,360; (1900) 15,184.

EDITOR OF "REVIEW."

Elkhorn: a river of Nebraska; rises in the northeastern part of the State, flows nearly southeastward through the counties of Madison, Stanton, Cuming, Dodge, and Douglas, and enters the Platte in the western part of Sarpy County. Length estimated at 250 miles.

Elkhorn: village; capital of Walworth co., Wis. (for location, see map of Wisconsin, ref. 7–E); on Chi., Milwaukee and St. Paul R. R., 65 miles N. W. from Chicago, Ill., and 45 miles S. W. from Milwaukee. It has a fine Union school building, a beautiful park, comprising 6 acres of large oak-trees, and manufactures of butter and cheese, wagons, carriages, wood-saws, brick and tile, treadpowers, windmills, etc. It is situated in one of the richest farming districts in the State. Pop. (1880) 1,122; (1890) 1,447; (1900) 1,731.

EDITOR OF "INDEPENDENT."

Elkin, WILLIAM LEWIS: astronomer; b. in New Orleans, La., Apr. 29, 1855; took the degree of Ph. D. in astronomy under Winnecke at the University of Strassburg in 1881; soon after went to the Cape of Good Hope, where he was for a time the coadjutor of Dr. David Gill at the Royal Observatory. Returning to the U. S. he became astronomer at the observatory of Yale College, where he has since devoted himself to work of the highest precision with the heliometer. His principal subjects of research have been the parallaxes of the fixed stars and of the sun, the satellites of Jupiter and Saturn and the Pleiades. S. NEWCOMB.

Elk, Irish: a large, extinct deer, *Megaceros giganteus*, whose remains are found in the Pleistocene of Northwestern Europe, and are particularly abundant and well preserved in the peat-bogs of Ireland. It attained a height of 6 feet at the withers. The antlers, which stand at right angles to the cranium, are flattened and palmate; they are usually about 6 or 7 feet from tip to tip, but specimens 11 feet across are known. Although popularly termed elk, this extinct deer is the sole representative of a distinct division of the deer family, and has no near living allies. F. A. L.

Elk Lake: See the Appendix.

Elk River: a river of West Virginia; flows nearly westward through Braxton and Clay Counties, and enters the Great Kanawha at Charleston. Length, nearly 150 miles.

Elk River: village; capital of Sherburne co., Minn. (for location of county, see map of Minnesota, ref. 8–E); on the Mississippi river, and the Great Northern and N. Pacific R. Rs., 38 miles N. W. of St. Paul; in a farming region. It has a brick schoolhouse and manufactories. Pop. (1900) 831.

Elkton: town; capital of Todd co., Ky. (for location of county, see map of Kentucky, ref. 5–E); on the Louisville and Nashville Railroad; 20 miles E. S. E. of Hopkinsville. It is in an agricultural and tobacco-growing region, and has several churches, public schools, and two weekly newspapers. Pop. (1880) 874; (1890) 1,158; (1900) 1,123.

Ell [O. Eng. *eln*: O. Norse *oln*: O. H. Germ. *elina*, Mod. Germ. *Elle*: Goth. *aleina*, with fundamental meaning forearm; cf. Lat. *ulna*, Gr. *ὠλένη*, Skr. *aratni-*, elbow]: a measure of length adopted from the length of a man's forearm. The English ell is 3 ft. 9 in., and the Flemish is equal to 27 inches, or three-quarters of a yard.

Ellagic Acid [Fr. *ellagique*, by transposition of *galle*, gall-nut]: a constituent of certain animal concretions, as the bezoar-stones of the antelope; also produced by the decomposition of gallic acid.

Ellenborough, EDWARD LAW, Lord: lawyer; b. in Cumberland, England, Nov. 16, 1750. He was engaged in 1785 as the leading counsel for the defense in the trial of Warren Hastings, for whom he pleaded with success. Though he began his political career as a Whig, he was, like many others, driven into the Tory ranks by the fears which the French Revolution excited. He became attorney-general in 1801, and lord chief justice of the king's bench in 1802. In the same year he was created Baron Ellenborough. D. Dec. 13, 1818.

Ellenborough, EDWARD LAW, Earl of: statesman; son of Baron Ellenborough; b. Sept. 8, 1790, and succeeded his father as baron in 1818. He was Lord Privy Seal in 1828–29, and gained distinction as an orator in the House of Lords. In 1841 he was appointed Governor-General of India, where his brilliant but rash administration provoked the severest criticism. He was recalled in 1844 by the East India Company, and then received the title of earl and viscount. He was First Lord of the Admiralty in 1846 for a short time in the cabinet of Peel. On the formation of a new Tory ministry in Feb., 1858, he became president of the board of control. One of his dispatches, censuring Viscount Canning for his conduct in India, offended the public, and he had to resign in 1858. In 1852 he had outlined a home constitution for the Government of India, and when the transference of authority to the crown followed under Lord Stanley's presidency, Ellenborough's plan was carried out in all essential points. D. at Southam Hall, near Cheltenham, Dec. 22, 1871.

By his death the earldom became extinct, and the barony reverted to his nephew.

Ellensburgh: city; capital of Kittitas co., Wash. (for location of county, see map of Washington, ref. 5–F); situated on Yakima river and on the Northern Pacific Railroad, 135 miles E. S. E. of Seattle. It has six churches, State normal school and fine public schools, and is chiefly engaged in agriculture, stock-raising, and mining. Pop. (1890) 2,768; (1900) 1,737. EDITOR OF "CAPITAL."

Ellenville: village; Ulster co., N. Y. (for location of county, see map of New York, ref. 7–J); on railway and on the Delaware and Hudson Canal; 100 miles N. N. W. of New York city. It is situated in a beautiful and fertile valley at the foot of the Shawangunk Mountains, and is a favorite summer resort. It is the seat of Ulster Seminary, and has an academy and graded public schools, many handsome public and private buildings, a glass-manufactory, cutlery-works, stoneware pottery, bluestone quarries, manufactories of leather and boats, excellent water-works, and electric lights. Immense quantities of huckleberries are shipped from this point. Pop. (1880) 2,750; (1890) 2,881; (1900) 2,879. EDITOR OF "JOURNAL."

Ellery, WILLIAM: patriot; b. at Newport, R. I., Dec. 22, 1727. He was a merchant in his youth, and began to practice law in 1770 at Newport. Having gained a high reputation for integrity and wisdom, he was chosen a delegate from Rhode Island to the national Congress of 1776, in which he signed the Declaration of Independence. He was re-elected, and remained in Congress until 1785. In that year he actively supported Rufus King in his attempt to secure the abolition of slavery. In 1790 he was appointed collector of Newport, a position which he held till his death. He supported the Federal party. D. at Newport, Feb. 15, 1820.

Ellet, CHARLES: engineer; b. at Penn's Manor, in Bucks co., Pa., Jan. 1, 1810; devoted himself to mathematical and engineering pursuits, and became an assistant engineer on the Chesapeake and Ohio Canal. He then visited Europe, and after a course at the Polytechnic School in Paris returned to the practice of his profession, holding successively the positions of engineer on the Utica and Schenectady Railway, on the Erie Railway, and chief engineer of the James River and Kanawha Canal. He was the author of an *Essay on the Laws of Trade*, and of other works of a similar character. He built the bridge across the Schuylkill at Fairmount, the first wire suspension bridge in the U. S. In 1845 he affirmed that a bridge might be built across the Niagara below the falls, secure and fitted for railway uses; and he was in 1847 the designing and constructing engineer of the preliminary wire suspension bridge (a light foot-bridge), intended as a service bridge for the construction of the main work. During the civil war he was commissioned to do what he could to protect the Mississippi gunboat squadron against a fleet of hostile rams understood to be coming up the river. He hastily equipped a fleet of nine river steamboats as rams, of which he was given the command. In a subsequent battle (June 6, 1862), terminating in a decisive defeat of the Confederate squadron, he received a wound, from which he died at Cairo, Ill., on June 21.

Ellice Islands: a group of small islands in the South Pacific; N. W. of Samoa and N. of Fiji; discovered in 1819. They are atolls or coral islands and contain lagoons, which in two of the group, Lakena and Olosenga or Quiros Island, are of fresh water. Nui, another of the islands, is remarkable for the fine natural fountains caused by the water from the sea gaining access to the lagoon underneath the reef. The population, which exhibits the same general traits as that of Samoa, numbers about 2,500.

Ellichpur′: a district (and city) of East Berar, British India; between the parallels 20° 51′ and 21° 46′ N., and the meridians 76° 40′ and 78° 30′ E.; along the south side of the Tapti river. Area, 2,623 sq. miles. The northern half is in the Satpura mountains; the southern is flat and intersected by streams. It has no railways. The principal agricultural products are wheat (of excellent quality), rice, pulses, oil seeds, and timber. The principal town is Ellichpur, formerly a capital of the Deccan, and a place of importance, now with little trade. Pop. of the town, 27,000; of the district, 315,000. M. W. H.

Ellicott, ANDREW: civil engineer; b. in Bucks co., Pa., Jan. 24, 1754. He founded Ellicott's Mills in Maryland, and removed to Baltimore. He was a friend of Dr. Franklin and of Washington. In 1790 he was employed by the Federal Government to survey and lay out the capital of the U. S. He was appointed surveyor-general of the U. S. in 1792, and became Professor of Mathematics and Engineering at West Point in 1812. D. at West Point, Aug. 29, 1820.

Ellicott, CHARLES JOHN, D. D.: theologian; b. at Whitwell, near Stamford, England, Apr. 25, 1819, and was educated at Cambridge, where in 1859 he was appointed Hulsean lecturer and in 1860 Hulsean Professor of Divinity. In 1861 he became Dean of Exeter, and in 1863 Bishop of Gloucester and Bristol. His commentaries on the Epistles of St. Paul, which began to appear in 1854, put him into the front rank of biblical scholars. His *Historical Lectures on the Life of our Lord Jesus Christ* (1860) were the Hulsean lectures for 1859. His first work was a *Treatise on Analytical Statics* (1842).

Ellicott City: town (incorporated in 1867); capital of Howard co., Md. (for location of county, see map of Maryland, ref. 2–E); situated on the Patapsco river and the Balt. and O. R. R., 10 miles W. of Baltimore and 31 miles N. N. E. of Washington, D. C. It has 8 churches, a college, 5 public schools, a large flouring-mill, 2 cotton-factories, 2 barrel-factories, a large paper-mill, a stone-crusher, granite quarries, electric lights, etc. Pop. (1890) 1,488; (1900) 1,331.

Ellinwood, FRANK FIELDS, D. D.: clergyman; b. in Kirkland, Oneida co., N. Y., June 20, 1826. He graduated from Hamilton College 1849, and took the theological course in Auburn (1851–52) and Princeton (1852–53) Seminaries. He was pastor in Belvidere, N. J., 1853–54, and in Rochester, N. Y., 1854–65; then was secretary of the committee of church erection for five years, and of the memorial fund committee 1870–71; in 1871 became secretary of foreign missions of the Presbyterian Church in the U. S. He published *The Great Conquest* (New York, 1876) and *Oriental Religions and Christianity* (1892). WILLIS J. BEECHER.

Elliot, ARTHUR R. D.: See the Appendix.

Elliott, CHARLES, D. D., LL. D.: clergyman; b. in Glenconway, County Donegal, Ireland, May 16, 1792; entered the ministry of the Methodist Episcopal Church. He emigrated to the U. S. in 1814, and went to Ohio in 1818, where he edited the *Western Christian Advocate* and other journals. He was a Professor of Languages at Madison College, Uniontown, Pa., 1827–31, and president of Iowa Wesleyan University 1856–60 and 1864–67; author of *A Treatise on Baptism* (1834); *Life of Bishop Roberts* (1853); *Delineation of Roman Catholicism* (2 vols., New York, 1842); *Sinfulness of American Slavery* (2 vols., Cincinnati, O., 1851); *History of the Great Secession from the Methodist Episcopal Church* (1855); *The Bible and Slavery*, etc. D. in Mt. Pleasant, Ia., Jan. 3, 1869.

Elliott, CHARLES LORING: portrait-painter; b. at Scipio, N. Y., Dec., 1812; pupil of Trumbull and of Quidor, New York; National Academician 1846. His portraits are well painted and excellent in color; he was considered by his fellow-artists the best portrait-painter of his time. His portrait of Prof. T. A. Thacher is in the Yale Art School; those of Erastus Corning and Asher B. Durand, the artist, are in the Corcoran Gallery, Washington. He painted the portrait of Matthew Vassar, at Vassar College. D. in Albany, N. Y., Aug. 25, 1868. W. A. C.

Elliott, EBENEZER: poet, called the "Corn-law Rhymer"; b. near Rotherham, Yorkshire, England, Mar. 17, 1781. He was not liberally educated, and was considered a dull boy at school. In early youth he worked in an iron-foundry, in which his father had been employed. He produced in 1798 *The Vernal Walk*, a poem. After he had worked for many years in the foundry he married and removed in 1821 to Sheffield, where he engaged in the iron-trade on his own account, and was successful. His most popular poems are *The Corn-law Rhymes*, which promoted the repeal of the corn-laws, and were much admired. He afterward wrote *The Village Patriarch* (1829); *Byron and Napoleon* (1831); *Love*, and other poems. His works are commended for their energy and the sympathy with the poor which they exhibit. D. at Great Houghton, near Barnsley, Dec. 1, 1849. See Ward's *English Poets* (2d ed. 1883).

Elliott, SAMUEL MACKENZIE: physician; b. at Inverness, Scotland, Apr. 9, 1811; studied at the Royal College of Surgeons in Glasgow, where he graduated in 1828, and in London; removed in 1833 to the U. S.; visited Cincinnati and Philadelphia, and settled finally in New York, where he acquired a great reputation as an oculist. At the outbreak of the civil war he was lieutenant-colonel of the Highland Guard, and was wounded in the first battle of Bull Run. He was subsequently commissioned to raise the Highland Brigade, and was made a brevet brigadier-general. D. at Elliottville, Staten Island, Apr. 30, 1873.

Elliott, Stephen: naturalist; b. at Beaufort, S. C., Nov. 11, 1771; graduated at Yale College in 1791; from 1812 until his death, president of the bank of the State; aided in founding the Literary and Philosophical Society of South Carolina, and the State Medical College, in which he became Professor of Natural History and Botany. He was for a time editor of the *Southern Review*. Author of *The Botany of South Carolina and Georgia* (Charleston, 1821-24). D. at Charleston, S. C., Mar. 28, 1830.

Elliott, Stephen: P. E. bishop; b. at Beaufort, S. C., Aug. 31, 1806; son of Stephen Elliott, the naturalist; graduated at Harvard College in 1824; was admitted to the bar of South Carolina and practiced from 1827 to 1833; ordained a deacon in the Protestant Episcopal Church in 1835, and became Professor of Sacred Literature in South Carolina College; ordained priest in 1836; chosen first bishop of the diocese of Georgia in 1840, and provisional Bishop of Florida in 1844; founded a seminary for young ladies at Montpelier, Ga., which was his home from 1845 to 1853. D. at Savannah, Ga., Dec. 21, 1866.

Elliott, Stephen, Jr.: brigadier-general in the Confederate army; b. at Beaufort, S. C., 1832; son of Stephen Elliott, first P. E. Bishop of Georgia. On the outbreak of the civil war he organized and equipped the battery known as the Beaufort Artillery. He commanded at Pinckney island Aug., 1862, and was promoted for gallant conduct; was in command of Fort Sumter during the protracted bombardment to which it was subjected; and in 1864 was severely wounded by the mine explosion near Petersburg, which incapacitated him from further active service for the remainder of the war. In 1865 he subscribed to the oath requiring him to support the Constitution of the U. S. and that of his own State; was a candidate for Congress. D. at Aiken, S. C., Mar. 21, 1866.

Ellipse [viâ Lat. *ellipsis*, from Gr. ἔλλειψις, defect, a falling short, deriv. of ἐλλείπειν, omit, fall short, so called by the Greek geometer Apollonius Pergæus, because the square of the ordinate "falls short of" the rectangle of the abscissa and parameter]: a hypotrochoid curve of the second order, one of the conic sections, formed by the intersection of a plane with a cone. If two fixed points be taken in a plane, and a third point be conceived to move around the two fixed points in such a way that the sum of the distances of the moving point from the fixed points shall always be the same, the moving point will describe an ellipse. The fixed points are the foci of the ellipse, and the point half way between the foci is the center. That axis of the ellipse which passes through the foci is the transverse or major axis; the axis through the center perpendicular to the transverse is the conjugate or minor axis.

If a moving circle roll along the concavity of the circumference of a fixed circle in the same plane, the radius of the former circle being half that of the latter, any given point in the plane of the rolling circle, within or without, will describe an ellipse. Various instruments for marking the ellipse have been devised on this principle.

Ellis, Alexander John, F. R. S., F. S. A.: philologist; b. at Hoxton, a suburb of London, June 14, 1814; graduated at Trinity College, Cambridge, in 1837; studied law at the Middle Temple for some time, but devoted himself finally to the study of phonetics, and published *Alphabet of Nature* (1845); *Essentials of Phonetics* (1848); *Plea for Phonetic Spelling* (1848); *Universal Writing and Printing* (1856); *Early English Pronunciation* (1869-89); *Glossic* (1870); *Practical Hints on the Quantitative Pronunciation of Latin* (1874), besides papers on various subjects. The family name, which was originally Sharpe, was changed by royal license in 1825.

Ellis, Edward Sylvester: See the Appendix.

Ellis, George: English scholar and antiquary; b. in 1745. He was a friend and correspondent of Walter Scott. Among his publications are *Specimens of the Early English Poets* (1790) and *Specimens of Early English Romances in Metre* (1805), both standard works. D. in 1815.

Ellis, George Edward, D. D., LL. D.: Unitarian minister and author; b. in Boston, Aug. 8, 1814; graduated at Harvard in 1833; pastor of the Harvard church, Charlestown, 1840-69. He wrote for Sparks's *American Biography*, and was Professor of Theology in the Divinity School at Cambridge 1857-63. Among his works are *A Half Century of the Unitarian Controversy* (Boston, 1857) and *The Puritan Age and Rule in the Colony of the Massachusetts Bay, 1629-1685* (1888). He was president of the Massachusetts Historical Society. D. in Boston, Mass., Dec. 20, 1894.

Ellis, Sir Henry: antiquary; b. in London, 1777; graduated at St. John's College, Oxford; became assistant librarian to the Bodleian at Oxford; received an appointment at the British Museum in 1800, and in 1827 was made chief librarian there. D. in London, Jan. 15, 1869. He wrote a large number of valuable works, of which the most important are *Original Letters Illustrative of English History* (1824-46): *Introduction to Domesday Book* (1833); *Elgin Marbles of the Classic Ages* (1847); and *The Townley Gallery of Sculpture* (1847).

Ellis, Henry Havelock: See the Appendix.

Ellis, Job Bicknell, M. A.: botanist; b. in Potsdam, N. Y., Jan. 21, 1829; educated at Union College. He has published many papers on the fungi of North America, and with B. M. Everhart, *North American Pyrenomycetes* (1892) and twenty-nine centuries of *North American Fungi* (1878-93), consisting of sets of 2,900 specimens. From 1885 to 1888 he was one of the editors of the *Journal of Mycology*.

Ellis, Robinson, LL. D.: classical scholar; b. at Baring, England, Sept. 5, 1834; educated at Balliol College, Oxford; elected fellow of Trinity College, Oxford, in 1858, and appointed Professor of Latin in the University College, London, in 1870. Returning to Trinity College in 1876, he has been university reader in Latin literature since 1883. He is best known as the author of an elaborate critical edition of *Catullus*, with notes (2 vols., 1889, 2d edit.), and a metrical translation; a commentary on Ovid's *Ibis* (1881); the *Fables of Avianus*, with prolegomena and critical apparatus; and of *Noctes Manilianæ* (1891). He is a frequent contributor to English philological periodicals and to the *American Journal of Philology*. Alfred Gudeman.

Ellis, Theodore Grenville: civil engineer; b. in Boston, Mass., in 1830. He began business in New England; subsequently engaged in mining surveys in Mexico; in 1861 settled in Hartford, Conn. In 1862 he accompanied the Fourteenth Connecticut Volunteer regiment to the battlefield as its adjutant, and was breveted a brigadier-general for his bravery. He was a member of the American Society of Civil Engineers, and its vice-president from 1873 to 1877. At the time of his death (Jan. 8, 1883) he had charge of the Government works on the Connecticut river.

Ellis, William: missionary; b. in London, Aug. 29, 1794; received a scanty education, and worked as a market gardener till 1814, but in that year offered himself as a missionary to the London Missionary Society, and after a profitable year of preparatory study was sent to the South Sea islands, Jan., 1816, where he remained till 1824, when the state of his wife's health obliged him to return to England. This mission, brief as it was, brought about marked improvement in the social and industrial, as well as in the religious, condition of the natives. In 1832 he was appointed foreign secretary to the London Missionary Society, and held that office for the next seven years. His wife having died in the meantime, he had married in 1837 Miss Sarah Stickney, the author of *The Women of England*, *The Poetry of Life*, *The Mothers of England*, and other popular works. After an interruption due to illness he resumed his work for the society, which sent him to Madagascar to inquire into the prospects of resuming a missionary enterprise there. Between 1853 and 1857 he visited the island three times, and he was again sent out by the society in 1863. D. June 25, 1872. His works, which are chiefly accounts of his travels and missionary labors, are both interesting and valuable. They are a *Tour through Hawaii* (1826); *Polynesian Researches* (1829); *A Vindication of South Sea Missions from the Misrepresentations of Otto von Kotzebue* (1831); *Village Lectures on Popery* (1851); *Three Visits to Madagascar* (1858); *Madagascar Revisited* (1867); and *The Martyr Church of Madagascar* (1870).

Ellis Island: a small island in New York harbor, about a mile S. W. of the city. It is owned by the Government of the U. S., and since 1892 has been used as the point of debarkation for immigrants. Castle Garden was formerly used for this purpose.

Ellora: town of Hindustan. See Elora.

Ellsworth: city (founded in 1867); capital of Ellsworth co., Kan. (for location of county, see map of Kansas, ref. 5-F); situated on Smoky Hill river and on the Union Pacific R. R.; 155 miles W. by S. of Topeka; also the terminus of a branch of the St. Louis and San Francisco Railway. It has 7 churches, a fine brick school-house, and 3 primary schools, and is the center of an extensive wheat belt and grazing section. Here are found valuable clays, gypsum, and mineral paints, and here was first discovered the immense salt-bed which underlies Central Kansas. Across the river are situated the G. A. R. reunion grounds, 160 acres, belonging to the State. Pop. (1880) 929; (1890) 1,620; (1900) 1,549. Editor of "Reporter."

Ellsworth: city and port of entry; capital of Hancock co., Me. (for location of county, see map of Maine, ref. 8-E); on railway and on the navigable Union river; 2 miles from its mouth, and 30 miles S. E. of Bangor. Several bridges cross the river here. The city has a public library, shoe-factories and many sawmills. Ship-building is carried on, and the trade in ice and lumber is important. Pop. (1880) 5,052; (1890) 4,804; (1900) 4,297.

Ellsworth, Ephraim Elmer: soldier; b. in Mechanicsville, N. Y., Apr. 23, 1837. At the outbreak of the civil war he became colonel of a zouave regiment in the Union army, and in taking possession of the city of Alexandria, opposite Washington, May 24, 1861, was shot dead by an inn-keeper from whose roof he had removed a Confederate flag.

Ellsworth, Oliver, LL. D.: chief justice; b. in Windsor, Conn., Apr. 29, 1745; son of a farmer; entered Yale College in 1762, but left in his junior year and completed his studies at the College of New Jersey, graduating with honor in 1766. He studied theology for a year, but abandoned it for the law; in 1771 was admitted to the bar of Hartford co., Conn.; in 1772 married Abigail Wolcott, member of an illustrious family of East Windsor; was appointed State attorney for Hartford County in 1775; in 1777 settled in Hartford and became the most eminent practitioner in the State. He represented Windsor in the General Assembly at the outbreak of the Revolution, and was one of the committee called the "Pay-table" that managed the military finances of the colony. In 1778 he was sent as a delegate to the Continental Congress, where he served on the marine committee and the committee of appeals. From 1780 till 1784 he was a member of the State Council. He left Congress in 1783, declining a re-election, and in 1784 became a judge of the superior court of Connecticut. In 1787 he was sent as a delegate to the convention at Philadelphia which framed the Federal Constitution, and took a leading part in its proceedings, but owing to temporary absence was not able to sign the instrument; was the most influential member of the State convention which in 1788 ratified this Constitution. In 1789 he was elected to the U. S. Senate, in which he gained distinction as a debater, as the chairman of the committee for organizing the U. S. judiciary, as a supporter of Washington's administration, and as the leader of the Federal party in the Senate. Through his influence John Jay was sent to England in 1794, and the treaty negotiated by Jay was upheld by the Senate. In 1796 President Washington appointed him chief justice of the Supreme Court of the U. S., to succeed John Jay, and his official conduct and decisions were approved by both political parties. In 1799 Judge Ellsworth was by President Adams appointed, with Gov. William Richardson Davie and William Vans Murray, envoy extraordinary to France, and aided in negotiating the treaty of Mar. 2, 1800, which terminated the strained relations between the two countries. Judge Ellsworth then resigned his office on account of ill-health, and, after a visit to England, returned to the U. S. in 1801, and in 1802 was re-elected to the State Council of Connecticut, on which he served until his death. In 1807 he declined the office of chief justice of the State. President Dwight (*Travels*) declared that after Mr. Ellsworth entered public life "no man, when Washington was not present, would be more readily acknowledged to hold the first character." He received the degree of LL. D. from Yale, Dartmouth, and the College of New Jersey. D. at Windsor, Conn., Nov. 26, 1807. See Van Santvoord, *Lives of the Chief Justices*.

Ellsworth, William Wolcott, LL. D.: jurist; son of Oliver Ellsworth, chief justice; b. at Windsor, Conn., Nov. 10, 1791; graduated at Yale College in 1810; studied law at Litchfield and at Hartford, Conn., which became his home; was admitted to the bar in 1813, and in that same year married Emily, eldest daughter of Noah Webster, the lexicographer. In 1827 he was appointed Professor of Law in Washington (Trinity) College, and held that office until his death. From 1829 till 1834 he served as a Whig in Congress, resigning to pursue his profession. While in Congress he prepared and reported a law of copyright which was adopted by the Government. From 1838 till 1842 he was Governor of Connecticut. He twice declined an election to the U. S. Senate, but in 1847 was elected judge of the superior court and of the supreme court of errors, retiring from the bench in 1861. D. at Hartford, Jan. 15, 1868.—His twin-brother, Henry Leavitt Ellsworth (1791-1858), a lawyer by profession, was from 1836 till 1848 U. S. commissioner of patents; published a number of reports on the science of agriculture, and *Digest of Patents from 1770 to 1839* (1840).

Ellwangen, el-vaang'en: an old town of Würtemberg; on the Jaxt; 45 miles E. N. E. of Stuttgart (see map of German Empire, ref. 7-E). It has a cathedral, a castle, a hospital, and a gymnasium; also tanneries and bleach-works. Pop. (1890) 4,606.

Ellwood, Thomas Crowell: author; b. in Oxfordshire, England, in Oct., 1639; a minister of the Society of Friends. His friend Isaac Penington secured for him in 1662 the position of reader to the poet Milton, who showed him the manuscript of *Paradise Lost*, and requested him to take it home and read it. On returning the manuscript, Ellwood suggested to Milton the idea of *Paradise Regained*, by asking, "What hast thou to say of Paradise found?" Among Ellwood's works are a *Sacred History* (1705); a poem called *Davideis* (1712); and an autobiography (1714), frequently reprinted (e. g. Boston, 1877, London, 1885). D. in Amersham, Mar. 1, 1713.

Elm [O. Eng. *elm*: O. H. Germ. *elm*, cognate, though with difference of ablaut, with Lat. *ulmus*, to which O. Norse *almr* exactly corresponds; Mod. Germ. *Ulme* shows direct dependence on the Latin word]: any tree of the genus *Ulmus* of the order *Ulmaceæ*, natives of Europe and North America, with alternate serrate leaves, which are oblique or unequally heart-shaped at the base. The ovary is two-celled, with a single anatropous ovule. The fruit is a one-celled membranaceous samara, winged all round. This genus comprises numerous species, five or more of which are indigenous in the U. S. The most remarkable of these is the *Ulmus americana* (white or American elm), a large ornamental tree, usually with spreading branches and drooping, pendulous boughs. It grows rapidly, often attains the height of 100 feet, and is admired as one of the most noble and beautiful of forest trees. Its favorite habitat is in moist woods where the soil is rich, and in the vicinity of rivers and creeks. The trunk sometimes ascends without branches 50 or 60 feet, and then separates into a few primary limbs, which gradually diverge and present long arched pendulous branches floating in the air. The wood of this tree is used for making hubs of wheels. Another species native of the U. S. is the slippery elm (*Ulmus fulva*), a smaller tree with a very mucilaginous inner bark, which is used in medicine as a demulcent. Among the important trees of this genus is the common English elm (*Ulmus campestris*), which grows in many parts of Europe, and is extensively planted in Great Britain. It is one of the chief ornaments of English scenery. The wood of this tree is compact, fine-grained, very durable in water, and is used for various purposes by wheelwrights, machinists, joiners, and ship-builders. It has a mucilaginous bark, which is esteemed as a medicine. The *Ulmus montana*, or wych elm, is a native of Scotland, and a tree of rapid growth, valuable for timber, which is used for the same purposes as the English elm. Europe also produces the cork-barked elm (*Ulmus suberosa*), a tall tree extensively planted in England, and named with reference to the corky ridges or wings on its branches. A valuable fine-grained wood is obtained from the *Ulmus alata*, winged elm or wahoo, which grows wild in the Southern U. S.

El Mahdi: See Mahdi, El.

Elmer, John: See Aylmer, John.

El Mesherif: See Berber.

Elmira: city (village of Newtown prior to 1828, chartered as a city in 1864); capital of Chemung co., N. Y.; on the Chemung river, and the Erie, the Del., Lack. and W., Auburn division of the Lehigh Valley, and the Northern

Cent. railways, with connections with the Tioga and Fall Brook lines; 264 miles by rail W. N. W. of New York city (for location, see map of New York, ref. 6–F). It is in a broad, fertile basin at the convergence of four beautiful valleys, defined by hills 600 feet high, and has an area of 4,747 acres. There are gas and electric light plants, 246 named streets and lanes, 2 large and 3 small public parks with total area of 75½ acres, and 3 lines of electric street-railway. The religious and educational institutions comprise 35 churches, 11 public schools, 3 parochial and 6 private schools, a free academy, and a convent academy. A large public library has been erected in memory of the late Prof. J. Dorman Steele, by his widow. The charitable and reformatory institutions are the Arnot-Ogden Hospital, Home for the Aged, Orphans' Home, the Anchorage (a refuge for females), an industrial school, and the State Reformatory, a model reform prison for young criminals. The city is noted for its manufactures, which include window glass, iron bridges, boilers, engines, fire steamers and trucks, woolen, silk, and cotton fabrics, shoes, and wooden products. The city also contains large railway shops, and is a coal-distributing center. There are 4 banks, 3 daily and 4 weekly newspapers, and 5 magazines. The assessed valuation in 1900 was, real, $15,704,020; personal, $1,192,278—total, $16,896,298; the bonded debt was $1,077,500; and the special franchise assessment, $719,560. The decisive battle of Newtown, in Sullivan's campaign against the Indians in 1779, was fought near the present city, and the spot is marked by a centennial monument. During the war of 1861–65 the city was a military rendezvous and the site of a prison in which many Confederates were confined. Pop. (1880) 20,541; (1890) 30,983; (1900) 35,672.

Joe H. Geer, editor of "Advertiser."

Elmira College, originally chartered as Auburn Female University in 1852, was transferred to Elmira in 1853, rechartered as Elmira Female College in 1855, and had the word "female" stricken from its title in 1890. It has an astronomical observatory, an extensive natural history museum, hall of music, and a faculty of 23 (1901): president, the Rev. A. Cameron MacKenzie, D. D.

Elmore: village; Ottawa co., O. (for location of county, see map of Ohio, ref. 1–E); on railway and on Portage river; 20 miles from Lake Erie and 16 miles S. E. of Toledo. It has 8 churches, excellent schools, a bicycle-factory, flouring-mill, stave-factories, a barrel-factory, brick and tile works, etc. Pop. (1880) 1,044; (1890) 1,198; (1900) 1,025.

Editor of "Independent."

Elo'bey Islands: a small group of islands in Corsico Bay, on the west coast of Africa, in lat. 1° N., belonging, with the neighboring mainland, to Spain. C. C. A.

Elocution [from Lat. *elocu'tio*, deriv. of *e'loqui*, *elocu'tus*, to speak out]: in its restricted sense, the impressive utterance of ideas through the voice alone; in a broader sense, the significant use of all the agents of expression employed in conveying ideas to other minds through voice, attitude, countenance, and gesture. Elocution in relation to the manner and method of the different forms of public address is generally styled delivery. A speaker's delivery has primary reference to his hearers. His discourse, whether original or not, is governed by his sincere purpose to influence the minds of his auditors by means of ideas communicated in language, and embodied in voice and gesture. Thought, arrangement, style, utterance, and action are all originated, energized, and directed by one vital principle—the earnest intention to transfer what is in his mind into the minds of his auditors. Delivery is the outward expression of the inward impression; like Wordsworth's conception of language, it is "thought incarnated." Elocution is not eloquence, it is merely the servant of eloquence; it is a means and not an end; it is the physical part of eloquence. Eloquence is living, convincing, persuasive address; but it is the delivery that gains the attention of an audience, elicits and sustains its sympathy, and often transports it with delight.

Expressive speech is chiefly applied to three departments of effort: (1) *Oratory*, with its ethical and practical ends of instruction, conviction, excitation, and persuasion; (2) *Recitation*, as in memorized public address, with its practical aim, and in dramatic representation and declamation, with their artistic ends; and (3) *Reading*, which includes all forms of delivery, from the manuscript or the printed page, as in written public address, with its practical purpose; and in the artistic interpretation of the works of great authors, with its æsthetic end, as in public dramatic readings.

Delivery, in these three connections, may be made the subject of study from three points of view—as a science, as an art, and as a critique. Delivery is not an exact science; it is a science as psychology, music, rhetoric, and æsthetics are sciences. The facts of delivery can be ascertained, studied, properly related, and classified according to their actual connections; their laws and principles can be deduced and formulated. When the facts of expression are honestly developed and systematized we may presume to speak within proper limits of a science of delivery. As a science, delivery naturally takes its place as a legitimate branch of æsthetics. The science of delivery is the science of a beautiful manner of public address. Elaborated discourse is the finest of the æsthetic arts. Its inseparable elements are the three constituent principles of beauty, viz., idea, material, and form. The idea—that is, the spiritual element—of public discourse is thought permeated with feeling and purpose. The material is sound—the human voice, and its frequent accompaniment, gesture; the form is the style of discourse, the unit of discourse being the word; in spoken discourse the form is the modulation of the voice and expressive movements of the body.

Under the first principle of æsthetics—that of the idea—it is natural to consider the end of delivery, the living intention of the speaker to transfer his thought and feeling to the minds of the audience. Thought and feeling in relation to delivery are mental states which prompt and govern the natural, outward signs of thought and emotion. These mental states are regarded as original sources of power in delivery. Good delivery is largely dependent upon clear thinking and earnest feeling. To secure the highest power in delivery, the subject matter, the idea of discourse, must be made as thoughtful as it is possible for painstaking thinking to make it. Then the speaker can speak with the power and accent of conviction. The expressive modulations of the voice, the changing rate of utterance, the varying degrees of force, are the effect of feeling in utterance. Oratorical and dramatic action, too, have their sources in the emotional rather than in the intellectual part of the mind. It is the feeling of anger and not its definition that contracts the brow, clinches the hand, and stamps the foot. The speaker's action should symbolize his emotional states rather than his intellectual.

A true theory of delivery must take note of the reciprocal influence between a speaker and his audience. Eloquence has been defined as "the joint product of the mental action of speaker and audience." The speaker is conscious of speaking directly to his hearers; he holds them in his mental grasp; he exerts a direct influence upon them. So long as a speaker maintains this consciousness of direct address to an audience he holds the attention and sympathy of his hearers. He, in turn, responds to the influence of their sympathetic attention.

Assuming the possession of clear, vigorous thought and quickened sensibility as original sources of inspiration, it is evident that the chief business of the speaker when actually confronting an audience is an affair of the soul—the *moral* part of delivery. The *character* of the speaker, his sincerity, sympathy, and uprightness, come to the front. "An orator," according to the Roman Cato, "is an upright man who understands speaking." The effective speaker is a good man aroused, with the power of communicating his enthusiasm. "The essential thing in speaking," says Emerson, "is heat, and heat comes of sincerity." But sympathy as well as sincerity must be manifested in public address. That was a true saying of a wise French preacher: "To address men well they must be loved much." Sincerity and sympathy not only enhance the power of delivery; they are also conditions of popular influence. Men refuse to surrender themselves to a speaker whom they believe to be deceiving them or indifferent to their welfare. The speaker's character gives character to his language, voice, and action.

The revelation of the mental, sympathetic, and moral elements of personality is concerned with the second constituent of delivery—the *material*. The idea of delivery regards the end of public address; the material takes account of the means and instruments employed in manifesting the substance of discourse. Delivery is now considered as an art for the purposes of teaching and discipline. Without the instruments of voice and gesture the transfer of thought and emotion can not be made. To obtain a scientific basis for a correct method of vocal culture requires acquaintance with certain facts of anatomy, physiology, and physics. The voice must be studied and exercised as a sound-producing body. Breath, as the material of tone, must be properly economized and directed. Control of the respiratory muscles must be acquired through systematic exercise in deep breathing. Any safe and effective system of vocal training must be grounded in the physiological laws of speech. The three physical properties of tone—(1) force (energy, loudness, intensity), (2) pitch, and (3) quality (*timbre*, clang-tint, character)—must be regarded as essential structural elements in a true method of vocal development.

Through the aid of the laryngoscope, and the researches of physicists like Helmholz, Czermak, Mayer, and König, a vocal technique for the formation and training of the voice need no longer be a matter of experiment and speculation. Vocal culture may proceed by a method which shall be at the same time natural, trustworthy, and scientific. The result of skillful training and persistent practice is the control of a voice which is at once powerful, resonant, sympathetic, of good compass, and that can be produced with ease and endurance.

In speech the natural effect of true vocal training would be a firm, incisive, yet easy and agreeable, enunciation; and closely allied with the utterance of language in complete discourse is a correct pronunciation, which is conformed to the standard authorities, that is, the best dictionaries of the English language. It is impossible to overestimate the value of the commonplace but fundamental virtues of enunciation and pronunciation in giving clearness and precision to speech.

Gesture, as the second instrument in revealing the *idea* and manifesting the speaker's personality, includes all significant movements of the body and limbs, and the expression of the countenance; it is the symbolical language of the emotions and passions of the soul. Hence gesture is significant action; but to be significant it should be reasonably rare. Insignificant action must be repressed; significant action must not be overdone. In teaching gesture great care should be exercised lest the instruction result in a mechanical and self-conscious style of action. The groundwork of discipline in gesture should be the use of æsthetic gymnastics of some approved method. Systematic practice in such exercises gradually corrects awkwardness, gives flexibility to the bodily movements, and a command of all the physical agents of expression. Significance in action is secured by observing the gestures which intelligent people spontaneously use when speaking under the influence of genuine feeling.

The third principle of æsthetic science, that of form, the special object of study and criticism, is the delivery of the complete discourse before an audience. The interpreting function of expressive speech, especially in the delivery of appropriated thought, is a department of literary criticism. All elaborate composition, like poetry or artistic prose, requires interpretation. The interpreting power of delivery is operative in every sentence a speaker utters. Complete oral expression implies a faculty of mental analysis of thought and language, and a power to sympathize with the purpose and feeling of an author, and with the order and movement of his ideas. Impressive utterance is often the truest revelation of an author's thought. Reading aloud increases the power of literary analysis. The interpreting power of the speaker is directly related to the receptive power of the hearer. "The best style," says Herbert Spencer, "is that which best economizes the recipient's attention." The law of mental economy is no less true of vocal than of literary style. Style in delivery involves the proper management of the voice in its method of enunciation, and in the use of both the intellectual and emotional elements of expression. The intellectual elements are emphasis, pause, and inflection; the emotional elements are force, pitch, quality, and rate of utterance. A slovenly enunciation, or a faulty use of any one of the elements of expression, dissipates and disturbs the hearer's attention; it puts an unnecessary strain upon his mental receptivity. The natural expression of clear thinking and true feeling, in the correct use of these elements, stimulates the hearer's attention, and enlarges his capacity for receiving ideas.

Style in gesture is directly related to *form*. Feeling suggests when action should be made; judgment and taste dictate the form of the gesture, and also a true economy of action with reference to frequency and significance. The mastery of the significant symbols of feeling contributes to variety in action.

The secret of an interesting and impressive style of speaking is an intelligent sympathy working through the imagination. The true method of delivery, both in public address and in artistic speech, is the natural method. True naturalness consists in observing the cardinal law of all expressive art, propriety, or the adaptation of manner to the varying form of the matter. Through the creative power of the imagination, spontaneously giving shape to all the intonations of the voice and to the significant movements of gesture, the speaker's personality is most completely manifested: "The style is the man."

In original discourse the natural method is that of good conversation, ennobled and idealized; it is a person's natural manner in earnest conversation on worthy themes raised to its highest power.

A good speaker always regards two things: one is found in the address itself, in the character of the subject matter; the other in the place, occasion, and circumstances of delivery. It is assumed that the speaker is master of the topic he is to present. Clearness and vigor of thinking, earnestness of purpose, and an active sympathetic imagination working in unison, spontaneously create the appropriate forms of utterance and action, and dispose the various elements of expression in harmonious relations. In the general management of delivery the speaker is careful to adapt his manner to the different parts of discourse. In the introduction he regards the place, occasion, and circumstances of delivery. He begins by directing eye and voice to the farthest auditors, speaking to them with the easy deliberation of pleasant conversation. His initial pitch and force take care of themselves, being instinctively and naturally determined by his dignified colloquial address to the distant auditors. Gesture is rarely needed in the introductory matter. If used, it is used sparingly, and in the colloquial and expository style. Deliberateness is the characteristic of the introduction. The discussion is conducted with an increased warmth of feeling, issuing in firm, full, resonant tones, an animated rate of utterance, and a positive expression of earnestness in countenance, attitude, and action. Variety is secured through the force and brilliancy given to the important ideas, and through fidelity to the theory of speaking in the method of impassioned conversation. Gesture is likely to be used because the feelings and imagination of the speaker are active. Energy of earnestness is the characteristic of the discussion. As the speaker enters upon the conclusion, he leads the audience to infer from his tones and manner that he is closing. Sometimes he concentrates his discussion into a brilliant climax; at other times he comes into a subdued and sympathetic relation to his audience; the force is softened, the quality is slightly aspirated, the rate is deliberate, and the pauses frequent though brief. The whole manner is persuasive. Even in the method of eloquent climax the artistic sense of the skillful speaker leads him to express a natural subsidence of emotion by delivering the few closing sentences in a slow and sympathetic manner. He returns to the mental plane of his auditors, but both speaker and audience are on a higher plane of thought and emotion than at the beginning of the discourse. The characteristic of the conclusion is impressiveness.

The artistic grouping of the parts of discourse into an organic whole imparts unity and concentration to delivery. The order, movement, and structure of discourse should be observed at the rhetorical points of transition. Transitions, or "landing-places," which mark the change from one aspect of the subject to another, should be properly indicated by changes in vocal treatment through some natural difference in force, pitch, rate, and pause. If a speaker, under the excitement of the occasion, feels that he is losing self-control in one or more elements of expression, let him take advantage of his "landing-places" to recover himself, and speak in his natural key and rate of movement. Sentences that contain an impassioned quality of thought should be delivered with appropriate energy and brilliancy, with the proper gradation of voice in approaching and in leaving the vigorous passage. Subordinate ideas are given with a force and an animation of movement consistent with a distinct enunciation and the clear communication of ideas.

Naturalness as related to the interpretation of elevated prose and to poetry deserves a passing mention. Prose, as distinct from colloquial speech, is an artistic or at least an elaborated production; therefore it must be delivered artistically—that is, under the influence of feeling and imagination. The best form of every-day speech is the basis and guide to the delivery of prose. But prose and almost all public address is ordinary speech idealized; feeling and imagination have entered into the ideas to ennoble them; the diction is choicer; the place, occasion, and circumstances of speaking are different from those of common conversation; the speaker is in a more elevated mood of mind; he receives influences from an audience which modify his ordinary feeling in private talk, and which have a tendency to magnify the ordinary elements of expression to suit them to the changed mood of the speaker and the external circumstances of delivery. Poetry, too, is carefully elaborated emotional thought, expressed in metrical form. Hence poetry must be read poetically—that is, in sympathy not only with the feeling and artistic purpose of the poet, but also with due care for the music of the phrase, delicately reminding the audience of the presence of rhyme and metrical rhythm, but always subordinating the technical elements of poetry to its inner soul and meaning.

In the public reading of the Scriptures good taste and the best usage have determined that the only instrument of expression is the voice. The reader of the Bible is not exercising the functions either of the orator, the actor, or the dramatic reader. His aim is not an æsthetic one, but an intensely practical one—to contribute to the culture of the spiritual life. He has no need of gesture, artistic attitude, or facial expression; he does not need, except for occasional emphasis, the magnetism of the eye. The reading should be vocal exegesis. He realizes his high aim of revealing the sense and spirit of the doctrine, or the narrative, or the scene he is interpreting, through the voice alone. But it is a voice charged with scholarly intelligence, with an appreciative sensibility that sympathizes with the purpose of the sacred writer, and with a chastened imagination that enters into the thought, feeling, and circumstances of the original utterance. Such an expressive reader does not assume appropriate modulations; his intelligent sympathy creates them; they have the accents of sincerity and reality.

The exposition of delivery as a science and an art naturally includes the consideration of delivery as a critique—delivery in its relations to the principles and practice of criticism. From this point of view delivery has for its object the study and exposition of the manifestations of oratorical and dramatic efforts. The inquiry into the nature, end, means, and method of public speaking furnishes the principles of delivery which can be applied to any specific instance of speaking, for the purpose of estimating its merit. Criticism is also largely a remedial art; it detects faults and suggests the proper means and methods of correcting them. Moreover, criticism is helpful as a formative influence in fashioning a natural manner of delivery. In overcoming specific defects it is often essential to insist upon the use of formulated rules and exercises which are derived from recognized principles of speech and action. But the judicious teacher always works for the preservation of the true individuality of his pupil; he aims at leaving the pupil at his best and in the full possession of all his native powers of manifesting his personality with freedom, naturalness, and self-forgetfulness. During the process of instruction the pupil is necessarily conscious of himself; the agents of expression and the objects of his self-criticism are parts and manifestations of his own mental and physical being. But the period of self-consciousness is one day passed. Self-mastery has been acquired through diligent practice in the universally recognized symbols of thought and emotion. After the symbols are mastered they are spontaneously used; the speaker's earnestness and sincerity have overcome his self-consciousness, and he speaks with the indefinable charm of self-forgetfulness. Self-consciousness may at first be inseparable from self-discipline; but before an audience the speaker must simply manifest the present *results* of culture. His attention must be given, not to the means and methods by which he conveys his ideas, but to the aim of fully and effectively communicating the subject of discourse to the minds of his audience. The control over the agents of expression and a due amount of experience in public speaking are essential conditions of attaining the elegance of ease. Delivery is an art that can be taught and learned; but in no other pursuit of culture is the truth of the familiar saying, "A little knowledge is a dangerous thing," so well exemplified. The harmony between the mental states and their embodied expression is the ripe fruitage of practice in true methods of culture. If, as has been said, "The charm of manner consists in its grace, its simplicity, and its sincerity," we must secure that charm by transforming art into a second nature, through acquiring "the art to conceal the art."

A final consideration is the importance of good health to the public speaker. The sustained physical vitality of the speaker and a proper regimen of life in regard to personal habits of sleep, diet, and exercise to promote that vitality are indispensable to the favorable mental moods, and to the animation and vivacity required in effective public address. The advantage of good health is seen especially in relation to the nervous system. Nerve-force is a physical source of power in delivery. Good health is conducive to the supply of nerve-force. Public speaking exhausts nerve-force, and the effort is often followed by a nervous reaction. The speaker in good health quickly recovers from the nervous exhaustion. Nerve-force can be economized, elicited, and developed, but no training can create it. Some speakers are called "magnetic," "electric." All true orators and great artists in dramatic and musical expression are conscious of a strange and often a bewitching power within. A subtle something animates voice, enunciation, attitude, and action, giving a sense of commanding power over the audience. Oratorical or artistic virtue goes out of them. For want of a better term we call this power magnetism. Whatever else it may be, magnetism is the union of nerve-force on the physical side with that peculiar quality of mental temperament and earnestness of nature best named as "soul." Magnetism is the life of public speaking and one great secret of its influence. A "natural speaker" without the advantages of training achieves remarkable success in oratory or the drama because of a rich endowment of magnetic force and the corresponding gift of communicating it. All effective and interesting speakers possess in varying degrees a good supply of nerve-force, though they may not be aware of its possession. A speaker in good physical condition unconsciously manifests this power. The chief physical means of eliciting and developing magnetism and of properly economizing and distributing it, is faithful, judicious, systematic physical training, and special culture in the art of delivery. In the act of public speaking the speaker must express and not repress its manifestation. The expression, however, must be consistent with self-control. There is a magnetic energy born of the mastery of strong emotion. A concentrated delivery is the expression of a soul filled with intense feeling held in restraint. It is the impressive influence of reserved power. But there must always be power to reserve; there must be the presence of an inward fire. The restraint of unimpassioned speech is simply tameness. The "temperance" that gives "smoothness" to impassioned utterance is the moral part of delivery. The speaker retains his self-possession while allowing himself to be carried away.

From this survey of the most important features of the nature and method of a true delivery it will be seen that the art of public address can be placed upon a rational basis. It is grounded on scientific principles; it is vitally associated with anatomy, physiology, psychology, physics, hygiene, and especially with æsthetics as a legitimate department of that science. The art of address strikes its roots far into the deepest and richest soil of the man himself. Delivery is nothing less than the man and the whole man speaking—communicating himself. The full and free communication of life to the rational and emotional life of his fellow-men for some beneficent purpose is the end and ideal of public speech. Effective delivery implies vitality, naturalness, and communicating power. Power must have guidance, and art gives that guidance. The natural result of patient elocutionary study and practice under judicious tuition is well directed, available, and polished power.

Convincing arguments for the utility of the practical study of delivery can be adduced from the overwhelming testimony of the greatest masters of the art of speaking, both in ancient and in modern times. The art of delivery is not one of the fine arts, but in its vital relations to effective public address and to the critical interpretation of the products of the greatest minds of the race it is a liberal art, and one that directly contributes to the development of personal power. Its dignity as an art is demonstrated in its important function of aiding men effectively to use the gifts and graces of mind and character.

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J. W. CHURCHILL.

Elmwood: town; Peoria co., Ill. (for location of county, see map of Illinois, ref. 4–D); on the C., B., and Q. Railroad; 26 miles W. by N. of Peoria. The chief industries are agriculture, mining, and manufacturing. Pop. (1880) 1,504; (1890) 1,548; (1900) 1,582.

Elongation [from Lat. *elonga're*, remove to a distance]: in astronomy, the apparent angular distance of a planet from the sun. The greatest elongation of Mercury amounts to about 28° 30′, that of Venus to about 47° 48′, and that of the superior planets may have any value up to 180°.

Elo'ra, or **Ellora**: a decayed town of Hindustan, near Dowlatâbâd; lat. 20° 5′ N., lon. 75° 13′ E. (see map of N. India, ref. 9–D). Here are numerous remarkable cave-temples, which surpass in magnitude all others in India, and are adorned with statues and other sculptures. Besides the cave-temples hewn out in the slope of a rocky hill, there are vast edifices or pagodas carved out of solid granite hills, so as to form magnificent monoliths, having an exterior as well as interior architecture, richly decorated. They are among the most stupendous monuments ever raised by man. The most remarkable of these, the temple called the *Kailás*, dedicated to Siva, is about 145 feet long and 100 feet high, and is supported by four rows of pilasters with colossal elephants beneath. In the court which surrounds the Kailás temple are several obelisks, sphinxes, and colonnades. Many mythological figures are carved on the walls. The date of the construction of these temples is not known. According to Fergusson, they were executed not later than 200 B. C. See Lassen's *Indische Altertumskunde* and Fergusson's *Handbook of Architecture.*

El Paso, el-paa'so: city and railway junction; Woodford co., Ill. (for location of county, see map of Illinois, ref. 4–E); 17 miles N. of Bloomington. It has large mills, several grain-elevators, carriage-factory, and agricultural-implement works. A coal-shaft has been sunk here. Pop. (1880) 1,390; (1890) 1,353; (1900) 1,441.

El Paso: city, railway center, and port of entry; capital of El Paso co., Tex. (for location of county, see map of Texas, ref. 3–B); situated on the Rio Grande. Near it the river passes through a mountain-gap called El Paso del Norte (North Pass), which is the chief thoroughfare between Mexico and New Mexico. On the opposite bank of the Rio Grande, in Chihuahua, Mexico, is Ciudad Juarez, formerly called Paso del Norte, a village important as the starting-point of the Mexican Central Railroad, and having a custom-house, through which a large amount of goods pass in transit between the U. S. and Mexico. El Paso has numerous churches, five schools, a $200,000 federal building, smelters (including a copper plant), a refrigerator for beef and other meats, ice-factories, planing-mills, gas-works, electric lights, etc. Pop. (1880) 736; (1890) 10,338; (1900) 15,906.

EDITOR OF "TRIBUNE."

Elphinstone, Admiral: See KEITH, GEORGE KEITH-ELPHINSTONE.

Elphinstone, Hon. MOUNTSTUART: historian; b. in Scotland, 1779; a younger son of Lord Elphinstone. He entered the Bengal civil service in 1795, was sent as ambassador to the court of Cabul in 1808, and was governor of Bombay 1819–27. Bishop Heber expressed the opinion that he was "in every respect an extraordinary man," and that his Indian policy was wise and liberal. Mr. Elphinstone resigned in 1829, and returned to England. He published an *Account of Caubul* (1815; 2d ed. 1841) and a *History of India: the Hindoo and Mohammedan Periods* (2 vols., 1841; 6th ed. 1874), both of which are highly esteemed. His *Life* (1884) was written by Sir E. Colebrooke, who edited his posthumous volume *The Rise of British Power in the East* (1887). D. Nov. 20, 1859.

Elphinstone, WILLIAM: prelate and statesman; b. in Glasgow, Scotland, 1431; graduated at the University of Glasgow 1452; and afterward, taking holy orders, officiated as priest of the Church of St. Michael for four years. He became a student of civil and canon law in the University of Paris, where his reputation for learning caused his appointment to a professorship, which he held six years. Returning to Scotland, he was appointed rector of the University of Glasgow, and subsequently held the important office of official of Lothian. In 1478 he became a member of the privy council. With the Bishop of Dunkeld and the Earl of Buchan he brought about a reconciliation between James III. and Louis XI., a service that procured for him the see of Ross, which was afterward exchanged for that of Aberdeen. Having been made chancellor of the kingdom in 1484, he again distinguished himself as a diplomatist by the success of his negotiations with the English king and of his mediations between the barons and his own sovereign, now James IV. He was next intrusted with the mission to the Emperor Maximilian to arrange a marriage between James and the emperor's daughter. In this he failed, but succeeded in completely restoring friendly relations with the Dutch. From the year 1492 to his death he held the office of privy seal. It is as a patron of learning that he is best known. The foundation of the university at Aberdeen was due almost entirely to his influence, and King's College owes its erection and maintenance to his care and liberality. D. Oct. 25, 1514. He wrote a history of Scotland, a book of canons, and some biographies of Scotch saints.

F. M. COLBY.

El Rosar'io: town of Sinaloa, Mexico; 55 miles E. of Mazatlan (see map of Mexico, ref. 5–E). Here were rich gold mines, which are no longer worked. It is an entrepôt of trade between Mazatlan and the interior. Pop. 5,000.

El'sass: See ALSACE.

Elsass-Lothringen: See ALSACE-LORRAINE.

Els'heimer, ADAM: landscape-painter; called by the Italians IL TEDESCO (i. e. the German); b. at Frankfort-on-the-Main in 1574. His works are highly finished. He excelled in chiaroscuro and in faithfulness to nature. He worked mostly in Rome, and died in that city in want in 1620.

Elsinore, el-si-nōr' (Dan. *Helsingör*): an old town and seaport of the island of Seeland, Denmark; on the western shore of the Sound (here only 2½ miles wide); 24 miles N. by E. of Copenhagen. It is defended by the castle of Kronborg, which commands the Sound at its narrowest part. It has a cathedral, a custom-house, and a royal palace called Marienlist, from which is obtained a magnificent view of the Sound and of Helsingborg in Sweden. At Elsinore until 1887 dues were collected from foreign vessels navigating the Sound. It has an active trade, and some manufactures of arms, brandy, hats, etc. Here was laid the scene of Shakspeare's *Hamlet*, and a mile from the city Hamlet's grave is shown. Pop. (1890) 11,082.

El-Siwah, el-see'wăa (anc. *Ammonium*): the most northerly of the five Egyptian oases; about 440 miles W. N. W. of ancient Thebes. It is 6 miles long and 3 broad. The oasis abounds in salt and alum, which were anciently exported. Dates, pomegranates, and other fruits are produced in very large quantities. Sheep and cattle are bred in great numbers. The oasis abounds in fresh-water springs, and is in part rather marshy. The ruins of the temple of Ammon and of other ancient buildings are still in existence. Pop. about 8,000. Chief town, Kebir.

Elson, Louis Charles: journalist and musicographer; b. in Boston, Mass., Apr. 17, 1848, and educated there; in 1877 he became the assistant editor of the *Vox Humana*, and in 1879 sole editor. He has been for a number of years the music critic of the Boston *Advertiser*, and was also on the editorial staff of the Boston *Musical Herald*, and is a lecturer in the New England Conservatory of Music. He has published a *History of Music in Popular Form*, *History of German Song*, *Curiosities of Music*, and other works, and has written original words for many songs, and has translated and adapted many foreign vocal compositions.
D. E. Hervey.

El'ssler, Fanny: dancer; b. in Vienna in 1810. She performed with success in Berlin, Paris, and London. With her sister Therese, who was also a danseuse, she visited the U. S. in 1841. She retired from the stage with a large fortune in 1851. D. Nov. 28, 1884.—Her sister Therese was united in morganatic marriage with Prince Adalbert of Prussia in 1851, and was made Freifrau von Barnim by the king in the same year. D. in 1878.

Elster, Black: river of Germany; rises in Saxony, flows northwestward, and enters the Elbe 8 miles E. of Wittenberg. Length, 112 miles.

Elster, White: river of Germany; rises near the northwestern frontier of Bohemia, flows northward, and after a course of 122 miles enters the Saale 3 miles S. of Halle.

El'ton: a shallow saline lake of Russia; in the basin of the Caspian, government of Astrachan; 150 miles S. S. E. of the town of Saratof. It is 14 miles long, and has an area of 78 sq. miles. About 100,000 tons of salt are annually procured from it. In the summer it presents an appearance as if it were covered with snow.

Elton, Charles Isaac: See the Appendix.

Elutriation [from Lat. *elutria're*, cleanse]: the process of preparing earths and pigments by washing them in large quantities of water, so that the heavier particles sink to the bottom, and the finer particles, remaining longer suspended, are gradually deposited. This operation is a very important one in preparing clay for the porcelain manufacture and some ores of iron and other metals for the furnace. The apparatus used for this purpose is a vat in which grinding wheels revolve, and into which a stream of water flows, but there are many adaptations of the process.

El'vas (Sp. *Helves*, or *Yelves*): a fortified frontier city of Portugal; province of Alemtejo; about 125 miles E. of Lisbon and 12 miles W. of Badajos, Spain (see map of Spain, ref. 17–C). It stands on a steep hill, is inclosed by walls, and is said to be the strongest fortress in Portugal. It contains many antique Moorish buildings, a cathedral, several convents, a theater, an arsenal, and a college. Elvas is supplied with water by a large Moorish aqueduct with several tiers of arches rising to the height of 250 feet. Its bishop is a suffragan of the Archbishop of Evora. Elvas was captured by the Spaniards in 1580, and again in 1808 by the French. Pop. 15,000.

Elves: See Elf.

Elwood: town; Madison co., Ind. (for location of county, see map of Indiana, ref. 5–F); on the Pitts., Cin., Ch. and St. L. and Erie railways; 45 miles N. N. E. of Indianapolis. It is a shipping-point for grain and stock, and has grain-elevators, saw-mills, and manufactures of flax, lamp-chimneys, and plate-glass. Pop. (1890) 2,284; (1900) 12,950.

Ely, ee'li: city of Cambridgeshire, England; on the river Ouse; 72 miles N. N. E. of London and 16 miles N. N. E. of Cambridge (see map of England, ref. 10–K). It is situated in the fen country called the Isle of Ely. A monastery was founded here in 673, but it was destroyed by the Danes in 870 and not restored till a century later, by Bishop Ethelwold, of Winchester. Henry I. elevated Ely into a bishopric in 1107; and when the monasteries were dissolved, under Henry VIII., the conventual church was transformed into a cathedral. So far as the interior is concerned it is one of the most beautiful of English cathedrals, but its exterior is a singular mixture of various styles of architecture. The nave, which was completed in the middle of the twelfth century, is Late Norman. The Galilee, or western porch, which was created by Bishop Eustace (1198–1215), is Early English. The choir was originally Early Norman, but in the middle of the thirteenth century its Norman apse was pulled down and the church extended eastward by six more arches. The lady-chapel was begun by Bishop Hotham, who also rebuilt the Norman tower, much enlarged, in the form of an octagon, and crowned with a lofty lantern. The tower, as well as the lady-chapel, was designed by Alan of Walsingham. The total length of the whole structure from E. to W. is 525 feet; the height of the western tower is 220 feet. Another fine building is Trinity church, a handsome structure founded in 1321. Ely contains many interesting monuments. There are manufactures of oil, earthenware, and clay pipes. Pop. (1891) 8,017.

Ely, Isle of: a level, fenny tract of Cambridgeshire, England; the southern part of the Bedford Level; bounded S. by the river Ouse; area, 355 sq. miles. It was formerly in great part covered with water, but has been drained and reclaimed by numerous canals and ditches. Aquatic birds and marsh plants abound here. The soil is fertile, and produces good crops of hemp, flax, wheat, oats, etc.

Ely, Richard Theodore, Ph. D., LL. D.: political economist; b. at Ripley, N. Y., Apr. 13, 1854; educated at State Normal School, Fredonia, N. Y., and at Dartmouth and Columbia Colleges, graduating from the latter in 1876; studied in Europe 1876–79; received a degree of Ph. D., University of Heidelberg, 1879; Professor of Political Economy in Johns Hopkins University 1885–92; member of Baltimore and Maryland Tax Commissions, and secretary of American Economic Association; elected director of the School of History and Political Science, and Professor of Political Economy in the University of Wisconsin, June, 1892; author of *French and German Socialism* (1883); *Labor Movement in America* (1886); *Taxation in American States and Cities* (1888); *Problems of To-day* (1888); *Political Economy* (1889); *Social Aspects of Christianity* (1889).
C. H. Thurber.

Elyot, Sir Thomas: author and diplomatist; b. in Wiltshire, England, about 1490. The place of his education is not known, but the extent of his learning seems to prove him a university graduate. He held the office of clerk to the western assize from about 1511 to 1519, when he exchanged it for that of clerk of the king's council, a position which he held for six years and a half, as he complained, without compensation and without thanks. In 1532 he was sent on embassies to the pope and to the emperor, and while on the latter mission received instructions to cause the arrest of the Reformer Tyndale, but failed in the attempt. Though highly honored by his contemporaries for his learning, Elyot received but slight pecuniary rewards from his patrons for either his literary or official labors, and spent his life in straitened circumstances. D. at Carlton, Cambridgeshire, 1546. Of his works the most noted is *The Boke named the Gouernour* (London, 1531), which is a moral treatise on the way to fit a man for the duties of governing. Among his twelve other books are *Of the Knowledge that maketh a Wise Man* (1533); *Bibliotheca* (1538), the first Latin-English dictionary; *The Image of Governance* (1540); *Preservative against Death* (1545); *Defense for Good Women* (1545).
F. M. Colby.

Elyria: village and railway center; capital of Lorain co., O. (for location of county, see map of Ohio, ref. 2–G); beautifully situated at the confluence of the eastern and western branches of Black river; 7 miles S. of Lake Erie and 25 miles W. of Cleveland; has eight churches, a high school, a public library, a law library, an extensive automatic-screw factory, shears-factory, and other industrial establishments, gas-works, electric lights, etc. Sandstone is one of the chief exports. Pop. (1880) 4,777; (1890) 5,611; (1900) 8,791.
Editor of "Republican."

Elysée, The Palace of the: a celebrated residence in Paris, France; situated at the junction of the Rue du Faubourg St.-Honoré and the Avenue de Marigny. It was built in 1718 for the Count d'Evreux, and served successively as a residence for Madame de Pompadour, for her brother, the Marquis de Marigny, for extraordinary ambassadors, for the financier Beaujon, and for the Duchesse de Bourbon. After the Restoration it took the name of Hôtel de la présidence (Dec., 1848). It was at the Elysée that the *coup d'état* of Dec., 1851, was planned. During the Exposition Universelle of 1867 it served as a residence for visiting foreign potentates, and is now devoted to the use of the president of the republic.

Elys'ium, or The Elysian Fields (in Gr. ἠλύσιον πεδίον): in classic mythology, the place to which the souls of the virtuous were supposed to be transported after death. Elysium was variously represented as a part of Hades, as an island in the Western Ocean, or as located in mid-air. Some of the ancients imagined that the kingdom of Pluto was divided into two regions—Tartarus, in which the wicked were punished, and Elysium, the abode of the good.

Elytra: See ENTOMOLOGY.

Elze, el'tse, FRIEDRICH KARL: German Shakspeare scholar; b. at Dessau, May 22, 1821; studied at Leipzig and Berlin; taught in the Dessau gymnasium; called to the University of Halle as "ausserordentlicher" Professor of English in 1875; promoted to a full professorship in 1876. Elze's interests lay chiefly in the direction of modern English literature. He was a zealous member of the Deutsche Shakespeare-Gesellschaft and a frequent contributor to its *Jahrbuch*, which he edited 1868–79. Of his separate publications may be mentioned lives of Scott (1864); Byron (1870); and Shakspeare (1876); an edition of *Hamlet* (1857; 2d ed. 1882); *Notes on Elizabethan Dramatists* (3 vols., 1880–86; 2d ed. 1889); and *Grundriss der englischen Philologie* (1887; 2d ed. 1888). D. Jan. 21, 1889.

G. L. KITTREDGE.

El'zevir, or **Elzevier**: the name of a family of Dutch printers who lived at Amsterdam, Leyden, and other places, and were celebrated for the accuracy and beauty of their typography. They published excellent editions of many classic authors between 1583 and 1681. The first eminent printer of the family was Louis or Lodewijk, who was born at Louvain about 1540, settled in Leyden, and died about 1617, leaving five sons—Matthias, Louis, Giles (or Ægidius), Joost (or Jodocus), and Bonaventure, who were all publishers. The business was continued by Abraham, a son of Matthias, and his partner Bonaventure, who published duodecimo editions of the classics which are still highly prized for their beauty and correctness. The Greek New Testament is among their masterpieces. A press was established in Amsterdam in 1638 by Louis Elzevir (a grandson of Louis first mentioned), who published good editions of numerous authors. Several other members of the family were distinguished printers. At least 1,600 works were published by the Elzevirs.

Emanation [from Lat. *emana'tio*, an oozing out, deriv. of *emana're*; *ē*, forth + *mana're*, flow, ooze]: in the religions of India and of ancient Persia, in Neoplatonism, and in Gnosticism, a theory of ontology and of cosmogony which ascribes the origin of the universe and of all inferior beings to an outflow from the Deity. The name has also been applied to the good and evil influences which the heavenly bodies were formerly believed to send forth, and which were thought to determine the destinies of men.

Emancipation [from Lat. *emancipa'tio*, deriv. of *emancipa're*, formally release from authority or ownership: *ē*, forth + *mancipa're*, transfer, release by the formal act of the *manci'pium*, deriv. of *manceps*, one who acquires, purchaser, contractor; *man-* (*manus*), hand + *ca'pere*, take]: the act of freeing from subjection of any kind. In Roman law a son was regarded as the slave of his father, and could by a fiction of that law be freed by being sold (*mancipatus*) three times by the father. This enfranchisement was termed emancipation. Different modes of emancipation were afterward recognized by Roman jurisprudence. In countries where that law prevails the word signifies the exemption of the son from the power of the father, either by express act or implication of law. By the civil law of France, majority and emancipation are attained at twenty-one, and a minor is emancipated by marriage. The word emancipation is used in a general sense to signify the liberation of a slave, or the admission of certain classes to the enjoyment of civil rights, as CATHOLIC EMANCIPATION (*q. v.*).

Emancipation, Proclamation of: the most important document ever penned by a President of the U. S.; issued by President Lincoln, Sept. 22, 1862, as a notice to the Confederates to return to their allegiance, emancipation of the slaves being proclaimed as a result which would follow their failure so to return. The real Proclamation of Emancipation was the supplementary document of Jan. 1, 1863. This act was simply a war measure, based solely upon the President's authority as commander-in-chief of the army and navy.

PROCLAMATION OF EMANCIPATION.

I, Abraham Lincoln, President of the United States, and Commander-in-chief of the Army and Navy thereof, do hereby proclaim and declare that hereafter, as heretofore, the war will be prosecuted for the object of practically restoring the constitutional relation between the United States and the people thereof in those States in which that relation is, or may be, suspended or disturbed; that it is my purpose upon the next meeting of Congress to again recommend the adoption of a practical measure tendering pecuniary aid to the free acceptance or rejection of all the slave States, so called, the people whereof may not then be in rebellion against the United States, and which States may then have voluntarily adopted, or thereafter may voluntarily adopt, the immediate or gradual abolishment of slavery within their respective limits, and that the effort to colonize persons of African descent, with their consent, upon the continent or elsewhere, with the previously obtained consent of the government existing there, will be continued; that on the first day of January, in the year of our Lord one thousand eight hundred and sixty-three, all persons held as slaves within any State, or any designated part of a State, the people whereof shall then be in rebellion against the United States, SHALL BE THEN, THENCEFORWARD, AND FOREVER FREE; and the military and naval authority thereof will recognize and maintain the freedom of such persons, and will do no act or acts to repress such persons, or any of them, in any efforts they may make for actual freedom; that the Executive will, on the first day of January aforesaid, by proclamation, designate the States and parts of States, if any, in which the people thereof respectively shall then be in rebellion against the United States; and the fact that any State, or the people thereof, shall on that day be in good faith represented in the Congress of the United States by members chosen thereto, at elections wherein a majority of the qualified voters of such State shall have participated, shall, in the absence of strong countervailing testimony, be deemed conclusive evidence that such State and the people thereof have not been in rebellion against the United States.

That attention is hereby called to an act of Congress entitled "An act to make an additional article of war," approved March 13, 1862, and which act is in the words and figures following:

"Be it enacted by the Senate and House of Representatives of the United States of America, in Congress assembled, That hereafter the following shall be promulgated as an additional article of war for the government of the Army of the United States, and shall be observed and obeyed as such:

"ARTICLE —. All officers or persons of the military or naval service of the United States are prohibited from employing any of the forces under their respective commands for the purpose of returning fugitives from service or labor who may have escaped from any persons to whom such service or labor is claimed to be due; and any officer who shall be found guilty by a court martial of violating this article shall be dismissed from the service.

"SEC. 2. And be it further enacted, that this act shall take effect from and after its passage."

Also to the ninth and tenth sections of an act entitled "An act to suppress insurrection, to punish treason and rebellion, to seize and confiscate property of rebels, and for other purposes," approved July 17, 1862, which sections are in the words and figures following:

"SEC. 9. And be it further enacted, that all slaves of persons who shall hereafter be engaged in rebellion against the Government of the United States, or who shall in any way give aid or comfort thereto, escaping from such persons and taking refuge within the lines of the army; and all slaves captured from such persons or deserted by them, and coming under the control of the Government of the United States, and all slaves of such persons found on (or being within) any place occupied by rebel forces and afterward occupied by the forces of the United States, shall be deemed captives of war, and shall be forever free of their servitude and not again held as slaves.

"SEC. 10. And be it further enacted, that no slave escaping into any State, Territory, or the District of Columbia, from any of the States, shall be delivered up, or in any way impeded or hindered of his liberty, except for crime or some offense against the laws, unless the person claiming said fugitive shall first make oath that the person to whom the labor or service of such fugitive is alleged to be due is his lawful owner, and has not been in arms against the United States in the present rebellion, nor in any way given aid or comfort thereto; and no person engaged in the military or naval service of the United States shall, under any pretense whatever, assume to decide on the validity of the claim of any person to the service or labor of any other person, or surrender up any such person to the claimant, on pain of being dismissed from the service."

And I do hereby enjoin upon and order all persons engaged in the military and naval service of the United States to observe, obey, and enforce within their respective spheres of service the act and sections above recited.

And the Executive will, in due time, recommend that all citizens of the United States who shall have remained loyal thereto throughout the rebellion, shall (upon the restoration of the constitutional relation between the United States and their respective States and people, if the relation shall have been suspended or disturbed) be compensated for all losses by acts of the United States, including the loss of slaves.

In witness whereof, I have hereunto set my hand and caused the seal of the United States to be affixed.

Done at the city of Washington, this twenty-second day of September, in the year of our Lord one thousand eight hundred and sixty-two, and of the independence of the United States the eighty-seventh.

By the President: ABRAHAM LINCOLN.

WM. H. SEWARD, Secretary of State.

SUPPLEMENTARY PROCLAMATION.

Whereas, On the twenty-second day of September, in the year of our Lord one thousand eight hundred and sixty-two, a proclamation was issued by the President of the United States, containing among other things the following, to wit:

That on the first day of January, in the year of our Lord one thousand eight hundred and sixty-three, all persons held as slaves within any State, or any designated part of a State, the people whereof shall then be in rebellion against the United States, shall be thenceforward and forever free, and the Executive Government of the United States, including the military and naval authority thereof, will recognize and maintain the freedom of such persons, and will do no act or acts to repress such persons, or any of them, in any efforts they may make for their actual freedom:

That the Executive will, on the first day of January aforesaid, by proclamation, designate the States and parts of States, if any, in which the people thereof respectively shall then be in rebellion against the United States, and the fact that any State, or the people thereof, shall on that day be in good faith represented in the Congress of the United States by members chosen thereto at elections wherein a majority of the qualified voters of such State shall have participated, shall, in the absence of strong countervailing testimony, be deemed conclusive evidence that such State and the people thereof are not then in rebellion against the United States:

Now, therefore, I, Abraham Lincoln, President of the United States, by virtue of the power in me vested as Commander-in-chief of the Army and Navy of the United States, in time of actual armed rebellion against the authority and Government of the United States, and as a fit and necessary war measure for repressing said rebellion, do, on this first day of January, in the year of our Lord one thousand eight hundred and sixty-three, and in accordance with my purpose so to do, publicly proclaim for the full period of one hundred days from the day of the above first-mentioned order, and designate, as the States and parts of States wherein the people thereof respectively are this day in rebellion against the United States, the following, to wit: Arkansas, Texas, Louisiana, except the parishes of St. Bernard, Plaquemine, Jefferson, St. John, St. Charles, St. James, Ascension, Assumption, Terre Bonne, Lafourche, St. Mary, St. Martin, and Orleans, including the city of New Orleans, Mississippi, Alabama, Florida, Georgia, South Carolina, North Carolina, and Virginia, except the forty-eight counties designated as West Virginia, and also the counties of Berkeley, Accomac, Northampton, Elizabeth City, York, Princess Ann, and Norfolk, including the cities or Norfolk and Portsmouth, and which excepted parts are, for the present, left precisely as if this proclamation were not issued.

And by virtue of the power and for the purpose aforesaid, I do order and declare that all persons held as slaves within said designated States and parts of States are, and henceforward shall be, free; and that the Executive Government of the United States, including the military and naval authorities thereof, will recognize and maintain the freedom of said persons.

And I hereby enjoin upon the people so declared to be free to abstain from all violence, unless in necessary self-defense, and I recommend to them, that in all cases, when allowed, they labor faithfully for reasonable wages.

And I further declare and make known that such persons of suitable condition will be received into the armed service of the United States to garrison forts, positions, stations, and other places, and to man vessels of all sorts in said service.

And upon this, sincerely believed to be an act of justice, warranted by the Constitution, upon military necessity, I invoke the considerate judgment of mankind and the gracious favor of Almighty God.

In witness whereof I have hereunto set my hand and caused the seal of the United States to be affixed.

[L. S.] Done at the city of Washington, this first day of January, in the year of our Lord one thousand eight hundred and sixty-three, and of the independence of the United States of America the eighty-seventh.

By the President: ABRAHAM LINCOLN.

WILLIAM H. SEWARD, Secretary of State.

Eman'uel, surnamed THE GREAT: King of Portugal; b. in May, 1469. He succeeded John II. May 3, 1495, and married Isabella, a daughter of Ferdinand and Isabella of Castile. She died in 1498, and Emanuel married her sister Maria. His third wife, whom he married in 1519, was Eleonore, a sister of the Emperor Charles V. Emanuel promoted education, maritime enterprise, and commerce. During his prosperous reign the power and glory of Portugal were increased by the discoveries and victories of Vasco da Gama, Albuquerque, and Almeida in India and Brazil. Portugal was probably the greatest naval power of the world in his reign, which constitutes the golden age of Portuguese history. His power and renown were greater than any Portuguese monarch ever possessed, either before or since his time; but he greatly injured his country by the banishment of all Jews and the enforced conversion of their young children. D. Dec. 13, 1521.

Emarginate [from Lat. *emargina're*, remove the edge; *e*, forth + *margo*, *-inis*, edge]: (*a*) in botany, notched or indented at the apex: said of leaves. (*b*) In zoölogy, having a portion of the margin cut away, as of the border of the scapula, the tail of a mammal, or the feather of a bird.

Em'ba, or **Jemba**: river of Asia, in Turkistan or the Kirghiz territory. It flows southwestward, and enters the Caspian Sea. Length about 250 miles.

Embalming [deriv. of *embalm* < M. Eng. *enbaumen* < O. Fr. *embaumer*; *en-* + *baume* < Lat. *balsamum* = Gr. *βάλσαμον*, balsam; the *l* has been reintroduced into the spelling, though not into the pronunciation of the English word]: in general, the special preparation of a dead organism (human body, animal, or plant) to prevent ordinary decomposition or decay. The term in itself refers to the means, i. e. balms or balsams, employed by some of the ancients. As commonly used, it refers to the preservation of dead bodies for reasons connected with religious beliefs or from pride or sentiments of affection. On the other hand, for scientific purposes, as in museums of anatomy and zoölogy, although the process for rendering dead bodies permanent may be the same, it is usually designated *preservation* rather than embalming. *Petrifaction*, in which the form is left intact although the animal or vegetable substance has been replaced molecule by molecule by some mineral, does not properly come under the head of embalming or preservation as here used. It is a preservation of form and not of substance, while embalming aims to preserve both form and substance; furthermore petrifaction has not been successfully accomplished by art.

The cause of decay has been attributed to a supposed tendency of complex organic substances to break up spontaneously into simpler ones; but the profound physiological and chemical study of the nineteenth century has shown that these substances, having been built up by the life processes, remain stable until by the life processes they are again reduced to simpler substances with liberation of energy for the purposes of mental or physical action. After death the so-called organized or living ferments (various micro-organisms, especially putrefactive bacteria), which abound in all moist and warm or temperate climates, make use of this complex matter for their subsistence and multiplication. This furnishes the key to all methods of embalming or preservation—that is, some means must be employed to prevent the living ferments from acting upon the dead body. The means which are available and do not in themselves profoundly alter the tissues are (1) cold; (2) the displacement of the water in the body by some gum or resin; (3) drying; (4) saturation of the tissues by antiseptics. The durability of the dead body will then depend directly upon the time during which the conditions antagonistic to the living ferments can be maintained. That cold may preserve indefinitely is shown by the well-known case of the extinct hairy mammoth found in the melting ice of Northern Siberia, the flesh of which was so fresh that it was eaten by dogs and wolves. Insects in amber show how complete and permanent the preservation may be when the water of the organism is replaced by a resinous substance; and every large museum of natural history contains specimens of great antiquity in which the preservation is due to complete drying, or to a combination of drying and antiseptics, or to the use of antiseptics alone.

In the historical consideration of embalming the mind naturally turns to ancient Egypt on account of the extent to which embalming was carried in that country and the large number of bodies, or mummies as they are called, which remain practically as they were deposited in the catacombs thousands of years ago. It is thought that with the Egyptians the custom was largely due to a profound belief in the immortality of the soul, which would in some of its stages need the body again for perfect development.

Embalming as it was practiced in Egypt is sometimes said to be a lost art. In the sense that it is no longer practiced, this is true; but the way in which it was done is quite well known from the descriptions of Herodotus (484 B. C.) and Diodorus Siculus (44 B. C.), as well as by examinations of the mummies themselves, the last source of information being the most satisfactory in many respects, as it verifies both authors and gives much additional information. The process consisted in its simplest form of desiccation, with little or no wrappings or a light smearing with pitch. In the more elaborate methods, aromatics and the antiseptics found in their natron beds were used in addition to the drying. In the application of the natron (a mixture of sodium sulphate and chloride and potassium nitrate) a strong brine was made in which the body was soaked, sometimes as long as seventy days. In many but not in all cases of the best embalming the abdominal viscera were removed, and in part preserved separately or after preservation returned either to the outside or the inside of the body. The brain was in many cases broken up and removed by a curved metal rod inserted into the skull through the nostrils. In many cases the hair was clipped, but in others, especially women, it was left in tresses or arranged on the head as is still the custom. After the pickling process the cavities of the body were often partly filled with aromatics, cedar-wood dust, and dry earth, and in some cases parts of the body were gilded, especially the nails, and artificial eyes were inserted. The body was then wrapped in strips of linen cloth of varying degrees of fineness, and finally it was desiccated. Sometimes the desiccation preceded the wrapping, as shown by the charred condition of the mummy, in other cases part of the wrapping at least preceded the drying, as indicated by the charred condition of the wrappings next the body; both the circumstances just given show that artificial heat was used. Finally the wrapped and dried mummy was placed in one or more cases or coffins and then in the perfectly dry catacombs. Instead of the salting process just described, some of the mummies were embalmed by soaking or probably heating them in pitch, the pitch displacing the water and furnishing also a protective covering. These mummies are black and heavy and the features scarcely recognizable, while those previously described are brown in color, light, and although very greatly shrunken still retain some resemblance to the individual. If one considers for a moment the principles given above on which the preservation of the body depends, it will be seen that all the conditions were fulfilled by the Egyptian method, viz., the use of antiseptics, desiccation, mechanical protection by the wrappings and coffins, and finally the dry catacombs.

The Peruvian mummies were apparently simply desiccated by exposure to the dry cool air of the Andes, by covering them with dry sand, or by burial in calcareous earth. In such regions of continuous sunshine and dryness, septic organisms are almost wholly absent from the air; meat dries without becoming tainted, and wounds heal without the complications known and feared in a less pure atmosphere. For permanence in such situations, mechanical protection is all that is needed, and certainly some of the mummies of Peru retain the features of the individual in a condition as perfect as most of the elaborately preserved mummies of Egypt. There is, however, a certain weirdness in the appearance of the Peruvian mummies, due to their sitting posture.

In modern times the desire to preserve the distinguished dead, or those especially beloved, as well as the need of preserving the bodies of animals and of men for scientific purposes, has made constant demand for some means for temporary or permanent preservation, and as the knowledge of the causes or conditions under which putrefaction takes place have been determined with greater certainty, so much the more perfect have been the results obtained, because all the organs are left intact and much of the natural fullness of the body is preserved. The best examples are those saturated with and preserved in some antiseptic liquid like alcohol. Such bodies are as permanent as the vessels and the liquids that contain them. If they receive proper care there seems to be no end to their permanence, as may be seen by specimens in the great museums of the world. There are also great numbers of specimens first saturated with some antiseptic, like alcohol, mercuric chloride, zinc chloride, arsenic or some of the essential oils, or by a combination of two or more of the above, then dried and varnished. Such dry specimens have shown less tendency to deteriorate in the museums of moist climates like that of England than the Egyptian mummies. For the most permanent and perfect preservation, the method of nature in imbedding insects in amber must be imitated. This is done on a great scale in every biological laboratory in the world. The water of the specimen is displaced by alcohol or carbolic acid, etc., and then more or less indirectly by the use of turpentine, oil of cloves, etc.; the object is filled with Canada balsam, dammar, shellac, etc., and inclosed in the same. With a large body, like that of a man, the process would be somewhat expensive and require considerable time; but the time and expense would be far less than that attributed to the best Egyptian embalming (seventy days' time; cost, $1,000 to $1,500), while the results would be far superior. A body prepared in this way would require only mechanical protection to render it indestructible.

Most of the embalming of human bodies at the present day is not for the purpose of rendering them permanent, but to preserve them in their natural color and fullness until arrangements can be made for a funeral or during the time necessary for transportation in case of death away from home. The permanence depends on the thoroughness with which the body is saturated with the antiseptics, and the permanence of the antiseptics themselves. As ordinarily accomplished the body, except the eyes, which become greatly sunken unless specially preserved, retains its natural appearance for weeks or months if sealed in an air-tight coffin, to prevent evaporation and shrinkage. A body thus embalmed, if it were slowly dried, would retain far greater naturalness than most of the Egyptian mummies possess.

The method for temporarily embalming the dead is very simple. As it is necessary to saturate all the tissues with the antiseptic, a solution is made and injected slowly into the arteries (method of Ruysch and William Hunter). A vein is opened to allow the blood to escape and to aid in determining when the system is filled. The injection is usually continued till the embalming liquid runs out of the vein. It is usually better to inject part of the required amount and then the remainder after several hours. After the arterial injection the thorax is filled through a hollow needle passed through the body wall, and by the same means any gas or liquid in the abdomen or any of its organs is drawn off and the abdominal cavity filled with the antiseptic. The withdrawal of gas and the injection of the liquid into the abdomen may need to be repeated. For an adult from 2 to 4 quarts of embalming liquid usually suffices. Very soon after the arterial and other injections all odor of decomposition will disappear, for the antiseptics will destroy the putrefactive ferments, and thus cut off the possibility of their further action. If the body is to be kept for a considerable time, all but the face, neck, and hands are wrapped or bandaged with strips of cloth saturated with the antiseptic. To prevent the sinking of the eyelids, thin shells of wax (" eye caps ") are put under the lids.

The substances used for temporary embalmment are mercuric chloride (introduced by Chaussier about 1800), arsenic (introduced by Tranchina, of Naples, 1835), zinc chloride (introduced by Sucquet, about 1840). In the published formulæ of embalming fluids two or more of the above are usually employed. Sodium chloride or common salt is also an ingredient, and instead of water alone as a solvent, glycerin and alcohol are used; carbolic, salicylic, and benzoic acid and one or more of the essential oils are also frequently present. The solutions usually contain from 8 per cent. to 10 per cent. of the antiseptics.

Embalming has grown to great dimensions in the U. S., and is not left to physicians, but has become a prominent feature of the undertaking business, even in country villages. Large establishments have grown up to meet the demand for proper instruments and material, and there has been founded a so-called "college of embalming" to train undertakers in the art. Undertakers, as a rule, employ proprietary embalming liquids, the composition of which they know only in part or not at all. The half-dozen of these liquids analyzed were found to conform very closely to the formulæ published by scientific men, the efficient agents being mercuric chloride, arsenic, and zinc chloride.

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In the Index Catalogue of the library of the surgeon-general's office, at Washington, over 100 titles of books and papers relating to embalming are given under the headings Embalming and Mummies. SIMON HENRY GAGE.

Embankment: a mound of earth for a pier or quay, for defense against the sea or streams, or for carrying a roadway. In building embankments the slopes should be of a permanent nature, and the weight of the bank should not be so great as to force out the foot. The materials should be placed according to that angle at which they would begin to move if left to themselves. Gravel or hard stone may be laid at 34°, while clay is liable to slip if the materials are dressed to an angle of more than 26°. If required to resist the pressure of water on one side, the slope toward the water had better be 34°, and that toward the land 26°. The tendency of the subsoil of an embankment to be compressed under the load brought upon it may be resisted by filling the core with light materials and by widening the base. The best way to counteract this tendency is to isolate the foundation by driving piles.

Care should be taken to free the seating of an embankment from any water that may filter through it. Covering the slopes with turf is a useful precaution, but this can not be done when the bank is formed of gravel.

Among the greatest embankments of modern times are one of 1,750,000 cubic yards on the Ulm and Augsburg Railway in Germany, and the Oberhäuser embankment of 2,500,000 cubic yards on the Augsburg and Lindau line in the same country.

Embargo [Span. deriv. of *embargar*, arrest, impede; cf. Fr. *embarrasser*, Ital. *imbarrare*, all derivatives of the unexplained Romance root *barr-*]: a restraint or prohibition imposed by the government of a country on merchant-vessels or other vessels to prevent their leaving its ports. Embargoes are usually imposed in time of war, or when war is believed to be impending. They may sometimes prohibit the arrival as well as the departure of vessels. Embargoes are of two kinds, civil and hostile. An embargo being a stoppage or prevention of a vessel's quitting a port, there may be occasions where such a measure can be adopted in order to prevent war by keeping the vessels of a country safe from collision with the rules of belligerent powers. In this case the complete non-intercourse does not generally begin until vessels, especially of foreign powers, have liberty to leave the ports, laden or in ballast. This is civil embargo. Embargo was once thought to be an unexceptionable measure, but it is not much in use, and apparently will go out of use, for it puts obstacles in the way of commerce which all friendly states feel and must complain of. The *hostile* embargo here contemplated is a detention of the vessels of a particular nation which may happen to be in the ports of the injured country. These are detained by way of offset for a wrong done by the other country, in the hope that this attachment of the property of its subjects may lead to a peaceful settlement and prevent actual war. If war should ensue, this detention may be followed by confiscation. In Dec., 1807, the Congress of the U. S., at the request of President Jefferson, laid an embargo as an offset or retaliation against the British orders in council. This embargo was repealed by Congress in Feb., 1809. Revised by T. S. WOOLSEY.

Embassador: See AMBASSADOR and DIPLOMATIC AGENTS.

Embassy [or *ambassy*, viâ O. Fr. *ambassée*, from a deriv. of Lat. *ambactus*, servant, retainer, a word of Celtic origin, also introduced into Gothic as *andbahts*, servant. See AMBASSADOR]: a diplomatic mission; the function of an ambassador. In a technical or limited application, embassy signifies a mission presided over by an ambassador; that is, a diplomatic agent of the highest rank. The term is sometimes applied to a company of persons sent on a mission, including one or more envoys, secretaries, etc. The practical difference between these two kinds of diplomatic missions is absolutely nothing, but the difference in appearance and external trappings is very great, as an ambassador actually represents his sovereign, and must be treated accordingly, while the envoy is only a commissioner. See AMBASSADOR, ENVOY, and INTERNATIONAL LAW.

Ember Week [*ember* < O. Eng. *ymbren*, is probably a corruption of latter part of Lat. *quatuor tempora*, four seasons, pronounced as *quat'tempra*, *quatembra*, cf. Germ. *Quatember*, Dan. *kvatember*. It is commonly explained as O. Eng. *ymb*, around + *ryne*, course]: in the calendars of the Anglican and Roman Catholic churches, (1) the week after the first Sunday in Lent; (2) the week after Whitsunday; (3) that after Sept. 14 (Exaltation of the Cross); (4) that after Dec. 13. The Wednesday, Friday, and Saturday of these weeks are ember days, fasts for imploring the Divine blessing on the fruits of the earth and upon the ordinations which are performed at these times. The fasts are purely Western, and probably Roman in origin, although they may not date, as they are said to do, from Pope Calixtus I. The times were fixed by Gregory VII. in the eleventh century, and confirmed by the Council of Placentia (1095).

Embezzlement [Anglo-Fr. *enbesiler*, fraudulently destroy, O. Fr. *besiler*, lay waste, ravage; origin obscure]: in criminal law, the act of fraudulently appropriating to one's own use property held under some fiduciary relation, such as that of clerk or servant. It is not to be confounded with larceny. The definition of this offense is rigid, so that this branch of the criminal law is entangled with perplexing distinctions. Larceny is defined to be "the felonious taking and carrying away the personal property of another." The word "taking," as here employed, has been closely interpreted by the courts, and generally considered not to include the case of property held in trust, particularly where it came into possession of the trustee without first having passed into the possession of the real owner. There must have been a taking equivalent to a trespass. It became a maxim that without a trespass there could be no theft or larceny. So refined a distinction as the following has been maintained: Should a clerk or servant authorized to sell goods actually sell them, and, having received the price, convert the money to his own use, there is no larceny, because the master never had the *possession of the money*, and so the clerk could not be said to have "taken" it from him. On the other hand, if the clerk had put the money received on the sale into the master's money-drawer, and had afterward fraudulently abstracted it, he would have committed larceny, for the act of depositing the money in the drawer would have placed it *constructively* in the master's possession. The moral quality of the two acts is substantially the same, yet by the common law the one is a crime and the other is a simple breach of trust, for which the servant is responsible in a mere action for damages.

This imperfection in the law led many years ago to a statute in England, which created a new form of crime called embezzlement. The early English statutes included only the case of misappropriation by clerks or servants of individuals or private corporations. This form of legislation was copied in the U. S. There is now in England a much more comprehensive scheme. (See 24 and 25 Vict., c. 96.) The present act not only includes the former cases, but embraces a great variety of cases of breach of trust, such as that by factors, brokers, agents, trustees of charitable societies, officers of cities, and public servants generally. The range of each enactment of this kind is very comprehensive, including not only positive wrongs, but all forms of willful or fraudulent neglect of duty. It is by no means necessary under this legislation that the officer should appropriate the funds of a city to his own use. It is enough if he fraudulently appropriates or permits them to be appropriated to *any other use* than that to which they rightfully belong. The punishment is severe. The crime is made a felony, punishable by not more than fourteen nor less than three years of penal servitude, or else by imprisonment at hard labor for a fixed period. In the civil law embezzlement is recognized as a wrong, subjecting him who commits it to an action for damages or other proceeding by way of reparation. A salvor may forfeit his share of salvage, compensation by embezzlement; the forfeited share accrues, not to the other members of his class, but to the owner of the property saved. T. W. DWIGHT.

Embiotoc'idæ [deriv. of *Embiotoca*, the typical genus, from Gr. ἔμβιος, living + τόκος, offspring]: a remarkable family of fishes limited to the Northern Pacific Ocean, and especially represented on the shores of the U. S., and distinguished by their viviparity. It belongs to the order *Teleocephali* and sub-order *Acanthopteri*. The body is compressed and oblong; the scales are cycloid and of moderate size, and cover the entire trunk as well as head; on the back they form a sheath of from one to three rows wide at the base of the dorsal fin; this sheath diminishes backward to the end of the fin, and is separated from the back by a well-defined groove; the lateral line is continuous, and parallel with the back; the head is compressed and moderate; the nostrils double; the eyes lateral; the mouth has a moderate or slight lateral cleft; the lips simple, and more or less developed; the teeth are present on the jaws, but absent from the palate; the branchial apertures are ample, and continuous below; branchiostegal rays five or six on each side; the dorsal fin is oblong, and modified in two ways, severally characteristic of distinct sub-families; the anal fin is oblong, and armed in front with three slender spines; the anterior portion of the anal fin is developed in a peculiar way as a conduit for the milt and eggs; the pectoral fins are produced and more or less angulated, and the rays branched; the ventrals are inserted behind the bases of the pectorals, and each has a spine and five branched rays; the vertebral column has an increased number of vertebræ; the lower pharyngeal bones are confluent together; the stomach is simple, and pyloric cæca are absent. The family exhibits two distinct modifications of structure; in one (*Embiotocinæ*) the dorsal has its spinous portion rather less developed than the soft, and only composed of from nine to eleven spines. In the other (*Hysterocarpinæ*) the dorsal has the spinous portion much longer than the soft, and sustained by about fifteen or more spines. (1) The *Embiotocinæ* are by far the most numerous in forms, and the species are marine. By American naturalists fourteen genera are admitted—viz., *Ditrema*, *Hypsurus*, *Phanerodon*, *Embiotoca*, *Tæniotoca*, *Damalichthys*, *Rhacochilus*, *Amphistichus*, *Holconotus*, *Cymatogaster*, *Hypocritichthys*, *Hyperprosopon*, *Brachyistius*, and *Abeona*. (2) The *Hysterocarpinæ* are, as far as known, represented by but one species (*Hysterocarpus traskii*), which is peculiar to the fresh waters of the Sacramento river. All the species are viviparous, and the young are developed in small number in special uterine sacs. Some of the species are among the most common of the Californian fishes, and are brought to the markets in large numbers; they are known to the inhabitants by the name of perch, although they have no relation whatever with the perches properly so called of Europe and the Eastern U. S. On the whole, they are mostly nearly related to the *Labridæ* and *Gerridæ*, but their differential characters are very positive. THEODORE GILL.

Embla: in Scandinavian mythology, the first woman on earth. Usually explained as derived from *alm*, German *Ulme*, English elm.

Emblazonry: See HERALDRY.

Emblem [from Lat. *emble'ma*, mosaic work, inlaid work, ornament = Gr. ἔμβλημα, insertion; ἐν, in + βαλεῖν, throw]: a figurative representation which by the power of association suggests to the mind some idea not expressed to the eye; a symbol; a type; thus a balance is an emblem of justice. In bibliography, the book of emblems is a book containing a series of plates or pictures of emblematic subjects, with explanations, as the poems of Jacob Cats.

Emblements [O. Fr. *emblaement*, deriv. of *emblaer*, sow with grain: Ital. *imbiadare*: O. Fr. *blef* > Mod. Fr. *blé*, wheat < Lat. *abla'tum*, what is carried from the field, grain]: the growing crops of cereal grains and vegetables produced annually, not spontaneously, but by labor and industry. By the common law a tenant for life, or other tenant, whose estate depends on an uncertain event, is entitled to the emblements, although his lease may terminate before harvest-time. If a tenant for life die, his personal representatives may after his death claim the products of his labor. But if a term be brought to a close by the voluntary act of the tenant, he is not entitled to the emblements. Revised by F. STURGES ALLEN.

Em'blica officina'lis [for etymology of *emblica* cf. Pers. *āmleh*, Skr. *āmalaka*, the name of this tree]: a species of trees of the natural order *Euphorbiaceæ*; a native of India and the Malay Archipelago. It produces a small round fruit, which is very acid, has medicinal properties, and is used to make pickles. The wood is hard and valuable. The bark is used for tanning and for dyeing cotton black.

Embolism [from Gr. ἐμβολισμός, intercalation; ἐν, in + βαλεῖν, throw]: in the calendar, an intercalation of a day, as Feb. 29 in leap-year, or of a lunar month, as in the Greek and Hebrew calendars.

EMBOLISM, in pathology, is the presence of any foreign substance (*embolus*), being usually a portion of a clot of blood in the circulating blood. Emboli frequently come from the heart, where blood clots are common and the blood is much agitated. Embolism in the brain is a recognized cause of apoplexy. An extensive embolism of the lungs may lead to sudden death; a smaller one may lead to local pneumonia, abscess, pyæmia, or gangrene. When air enters the veins through wounds or other paths, it circulates as an embolus and has frequently caused sudden death. Embolism, though frequently fatal, is sometimes followed by recovery. The best treatment is the frequent administration of concentrated food and stimulants, keeping the patient in fresh air, and allaying irritation by opiates. Revised by WILLIAM PEPPER.

Embolite: a chloro-bromide of silver, found in the silver ores of Mexico and Chili.

Embossing [from deriv. of O. Fr. *boce* > Mod. Fr. *bosse*, boil, swelling: Ital. *bozza*: Span. *bocha*; borrowed from Teutonic; cf. M. H. Germ *butze*, lump]: the raising of parts of a surface in relief above the other parts, usually for ornamental purposes. The term is usually limited to the beating up of thin plates or sheets of metal, or the molding of leather, moistened paper, or the like, rather than to relief cut in marble or stone or cast in plaster or sulphur. It is also applied to embroidery in which the pattern is raised above the surface of the stuff. See CHASING, RELIEF, and REPOUSSÉ. RUSSELL STURGIS.

Embracery [from O. Fr. *embraser*, set on fire]: in law, the offense of endeavoring to corrupt or bribe a jury or to influence a jury by any corrupt motive. This offense is punishable by fine and imprisonment.

Embrasure [deriv. of *embraser*, *ébraser*, to splay, chamfer]: in fortification, an opening made in the parapet of a fortified place or the breastwork of a battery through which the guns are pointed. The embrasures are usually made about 2 feet wide at the interior extremity or neck, and half as thick as the parapet at the exterior crest. The sole or lower surface is at the height of about 2½ feet above the platform on which the carriage of the gun is placed. The object of such embrasures is to shield as much as possible the interior of the place, and yet leave space for the free action of the gun.

Embroidery [from O. Fr. *embroder*, deriv. of a subst. appearing in Ital. *bordo*, Fr. *bord*, border, hem, outer edge, a loan-word from Teutonic; cf. O. H. Germ. *bort*]: needle-work upon textile material, leather, or the like, with which are sometimes combined applied pieces of colored material, feathers, jewels, or even pieces of looking-glass. The object of embroidery is usually decoration, but names and initials are often worked upon articles of clothing, etc., for convenience, and heraldic bearings and other devices, whose purpose is only in a secondary sense decorative, have often been embroidered. In the nineteenth century embroidery has been much in use at times for women's garments, and at others almost wholly abandoned, except that done with linen thread on undergarments, which has never gone out of fashion altogether. The colored embroidery which has been used the most commonly and for the greatest length of time during the nineteenth century is that of India shawls, called Kashmir shawls, and often, erroneously, camels'-hair shawls. Apart from these, women of European race sometimes use embroidery in color on gowns or other outer garments of silk or other unwashable material, sometimes embroidery in crewels on cotton or linen, and sometimes white embroidery on white; but none of these fashions is lasting. At times it is considered elegant to have curtains embroidered, and even hangings for walls are occasionally decorated in this way. When such decoration is in fashion, besides the costly hand-embroidery, there is produced machine-made embroidery, which always has the fault of being mechanical in look, hard and formal. (See MACHINE WORK and DECORATIVE ART.) On the other hand, some attempt has been made to work with the needle decorative pictures of great richness, the subjects selected being those which allow of a somewhat close rendering of natural forms by needle-work. Thus on a blue silk ground, golden-yellow wheat ears below and flying bees above give an impression of summer, while the effect of the soft floss-silk upon the hard and smooth ground is exceedingly decorative. This work is also applied to women's garments, but not commonly; indeed it requires protection from wear, and often needs to be framed and glazed like a water-color drawing.

The decorative art of the past is very rich in the branch of embroidery, and Oriental nations kept the ancient traditions in force and continued to produce splendid work until the influence of European commerce destroyed or greatly injured and degraded those arts in the course of the nineteenth century. In antiquity the great simplicity of the dress of European nations caused embroidery to be less in use, but with the early Middle Ages it became a common adornment of costly dress throughout Europe. It is to be observed also that where the state of the industrial arts is low, embroidery is apt to develop more rapidly than weaving. Rich textile fabrics come only with some advance in general civilization. In this way it happens that the European Middle Ages are the time of the most general use of embroidery of many kinds. The dress of laymen and ecclesiastics and the decoration of church and domestic interiors called for it continually. England was especially the home of elaborate pictorial needle-work in the twelfth and thirteenth centuries.

Some few of the special kinds of embroidery may be mentioned here. *Couching* is the laying down of threads, as of gold or silver or floss silk, side by side upon the surface to be adorned, and holding them fast there by stitches of finer and stronger thread which may not show at all. The larger and softer thread is not dragged through the material of the ground. *Appliqué embroidery* is that which is done by cutting out pieces of cloth, velvet, or other materials, sewing these pieces fast to the ground, and working the edges with stitches. Such patches of stuff may be cut to resemble leaves or flowers, and stitches on their face may express veins or shading. *Cut-cloth embroidery* is a variety of this, or merely another name for it. *Chain-stitch embroidery* is named from the stitch, in which a loop of thread is left on the surface of the stuff to be adorned, and the needle takes the thread through that loop before making another; this is the most generally used of all kinds of work, and is the very essence of the pictorial embroidery of the Middle Ages, English work being especially noted for the fineness of the chain-stitch, by means of which faces and hands, even of small size, were delicately rendered. *Crewel work* is done with worsted thread, usually on cotton or linen. For the various thread embroideries, cut-work, etc., see LACE.

RUSSELL STURGIS.

Embryol'ogy [from Gr. ἔμβρυον, a young animal, fœtus + λόγος, discourse]; the history of the development of the young animal before birth. Embryology proper includes the description of all the changes, both anatomical and physiological, which take place in the body of the imperfect young, within either the uterus or the egg, in all classes of animals. The present article, however, will be devoted more especially to the embryology of the Vertebrata, or those animals having a spinal column, since the general plan of development is the same throughout this class, and is particularly important as illustrating the development of the embryo in the human species.

In all cases the development of the young animal begins from an *ovum*, or egg. The ova exist originally in the interior of the body of the female parent, where they are produced in certain organs contained in the cavity of the abdomen, termed *ovaries*. The ovaries, containing ova, are thus characteristic of the female organization, and form an essential part of its original structure. The ova, after being produced within the ovaries, at a certain period arrive at maturity, and are spontaneously discharged. If fecundated at this time by the influence of the male, they develop into embryos; if not, they lose their vitality after a short period and perish. Thus the formation of the embryo depends upon the union and fusion of two sexual elements—namely, the ovum produced by the female, and the fecundating element or spermatozoön contributed by the male.

In some kinds of animals, such as birds, batrachians, and most of the reptiles and fishes, the egg is first discharged from the body of the female, and the development of the embryo takes place within it subsequently, the young animal being at last hatched from the egg externally; such animals are called *oviparous*, or egg-laying animals. In other instances, as in some fishes and reptiles, all the true quadrupeds, and the human species, the ova are retained within the body of the female while the development of the embryo is going on; so that at last the fully formed embryo is produced alive; such animals are called *viviparous*, because they produce living young, instead of laying eggs like the former. Nevertheless, the process is essentially the same in both cases, and differs only in the duration in which the ovum is retained within the body of the female parent.

The ovum is a typical cell, and in its simplest form consists of a globular mass of albuminous matter mixed with oleaginous granules, and invested by a transparent, colorless, homogeneous membrane. The oleo-albuminous mass is termed the *vitellus*, or yolk, while the investing layer is called the *vitelline membrane*.

Within the vitellus lies a delicate transparent sac, the *germinal vesicle*, which corresponds to the nucleus of the cell, and is of great importance for the subsequent changes necessary for the preparation of the ovum for the reception of the male fecundating element. A second still smaller body, the *germinal spot*, occupies the germinal vesicle, and represents the nucleolus of the egg-cell.

In the human species and in mammals generally the ovum, as above described, forms a little sphere about $\frac{1}{120}$ of an inch in diameter. It is therefore nearly invisible to the naked eye, and requires examination by the microscope in order to distinguish its characters.

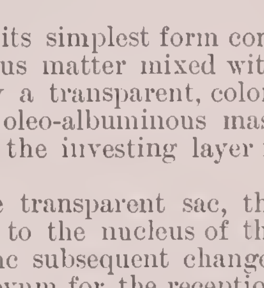


FIG. 1.—Ovum of the rabbit, from the ovary, magnified 90 diameters: *a*, vitellus; *b*, vitelline membrane; *c*, germinal vesicle; *d*, germinal spot.

Since the impregnated mammalian ovum is retained within the body of the female during the development of the embryo, and abundantly supplied with nourishment from the parent organism, such ova are provided with a very small quantity of nutritive material. In the oviparous classes, on the contrary, where the development of the embryo takes place outside the body of the parent, the egg is larger in size and more complicated in structure, and contains a store of nutritious material, as well as certain additional protective envelopes. In the common fowl, for example, the vitellus or yolk, which is the only part of the egg produced in the ovary, is nearly an inch in diameter, and contains a great abundance of oleaginous as well as albuminous material. After its discharge from the ovary, and during its downward passage through the generative canal, the size of the egg is still further increased by the deposit around the yolk of a layer of pure albumen, secreted by the lining membrane of the canal, and forming the so-called "white of egg." In the lower portion of the generative passage there are added to the outside of the albumen two fibrous membranes, called the "shell-membranes"; and lastly the calcareous shell, formed of a consolidated layer of the lime salts. These fibrous and calcareous envelopes serve to protect the embryo, while the albumen and the yolk supply it with the requisite nourishment during its formation in the egg.

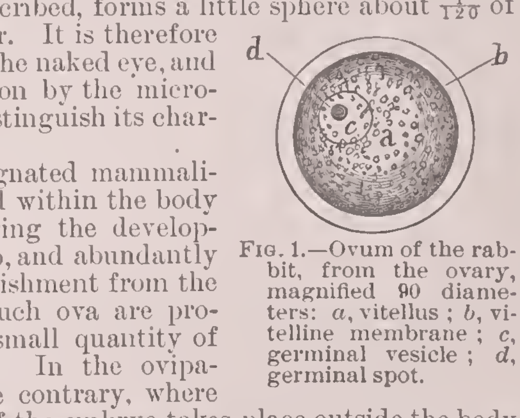


FIG. 2.—*a*, yolk; *b*, vitelline membrane; *c*, albumen; *d*, shell-membranes; *e*, egg-shell.

While the formation of the embryo follows the union of the male and female sexual elements, yet before the female cell is capable of becoming impregnated certain preparatory changes, collectively known as the *maturation of the ovum*, are necessary. These phenomena take place while the egg is still within the ovary, and consist essentially of a repeated very *unequal division* of the germinal vesicle or nucleus, resulting in the

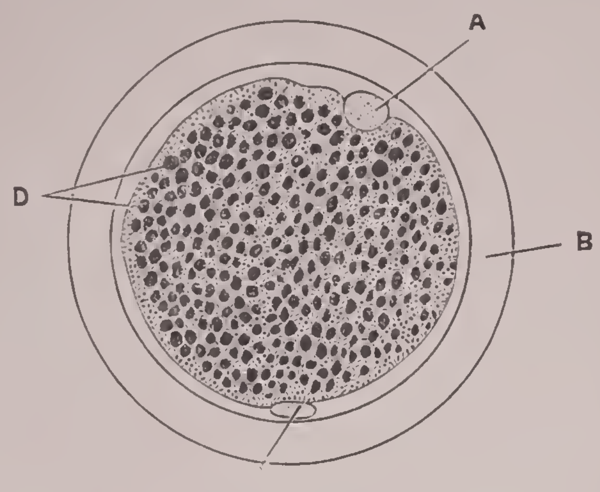


FIG. 3.—Unimpregnated ovum of cat: A and C, polar bodies; B, external membrane or zona pellucida; D, vitellus (after Bonnet).

expulsion from the ovum of two minute particles, the *polar bodies*, whose significance is still uncertain. The original germinal vesicle is replaced by a new body known as the *female pronucleus*; after the extrusion of the polar bodies and the appearance of the pronucleus, the ovum is ready for the reception of the male element. Maturation takes place in every completely developed ovum, irrespective of the possibility of future impregnation.

Conception or fertilization of the ovum follows the union of the ripe egg with the spermatozoön under favorable con-

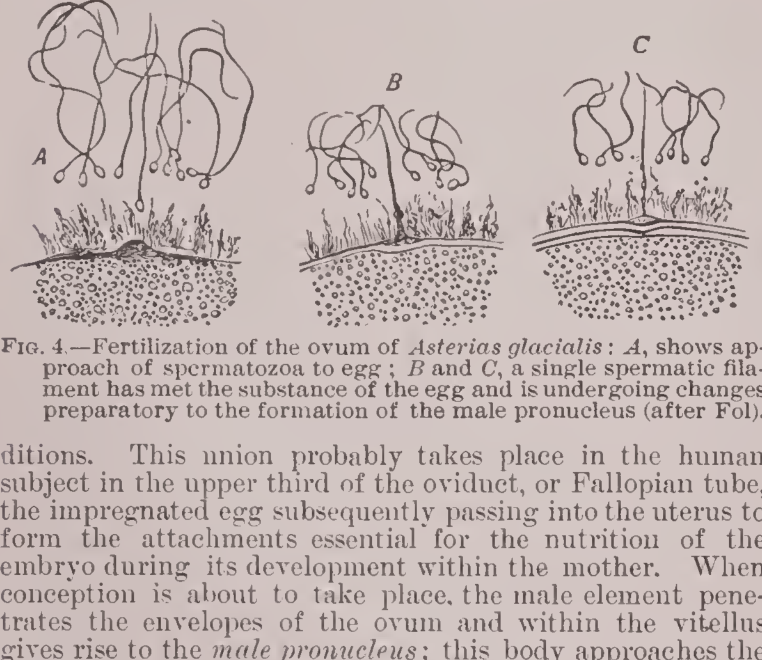


FIG. 4.—Fertilization of the ovum of *Asterias glacialis*: *A*, shows approach of spermatozoa to egg; *B* and *C*, a single spermatic filament has met the substance of the egg and is undergoing changes preparatory to the formation of the male pronucleus (after Fol).

ditions. This union probably takes place in the human subject in the upper third of the oviduct, or Fallopian tube, the impregnated egg subsequently passing into the uterus to form the attachments essential for the nutrition of the embryo during its development within the mother. When conception is about to take place, the male element penetrates the envelopes of the ovum and within the vitellus gives rise to the *male pronucleus*; this body approaches the previously formed *female pronucleus*, the two finally fusing to produce a new structure, the *segmentation nucleus*, the immediate element in which the formation of the future embryo begins. The new being therefore originates from a

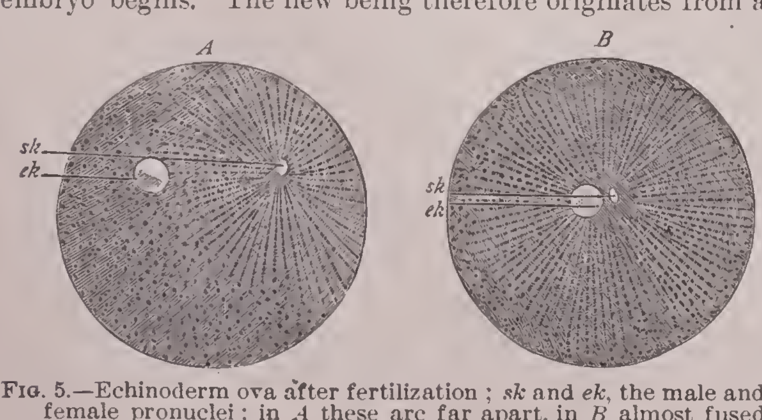


FIG. 5.—Echinoderm ova after fertilization; *sk* and *ek*, the male and female pronuclei; in *A* these are far apart, in *B* almost fused (after O. Hertwig).

cell which results from the fusion of the sexual elements of *both parents*, and which contains the potentialities contributed by both father and mother. In the history of conception, as now understood, is found the explanation of the striking transmission to the offspring of the characteristics of both parents which often seems so remarkable.

In all instances, without exception, the first indication of the commencing formation of the embryo in the ovum is

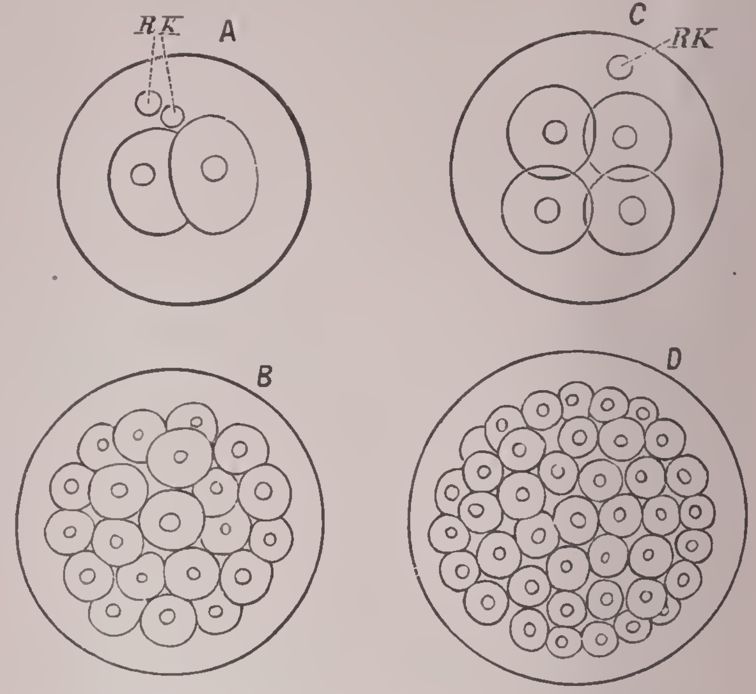


FIG. 6.—Diagram of segmentation of mammalian ovum: *A* and *C*, first and second stages of division; *B*, later stage; *D*, stage of the mulberry-mass; *R K*, polar bodies (after Bonnet).

the establishment of *segmentation*, whereby the original cell becomes divided by repeated cleavage into innumerable smaller elements from which are derived the various tissues and the organs of the new being. This process consists in the separation of the *segmentation nucleus* into two smaller nuclei, the division being accompanied by a corresponding constriction and separation of the cell-body or the vitellus into *segmentation spheres* by the appearance of a furrow running around the vitellus like an equator, which gradually deepens until it has completely separated the two hemispheres from each other. At the same time, or a little later, a second furrow, placed at right angles to the first, runs around the vitellus in another direction; and thus the two secondary globules are divided into four. By a repetition of this process the original cell, which had the form of a simple sphere, becomes converted into an aggregation of *segmentation spheres*, which from its external appearance is known as the *morula*, or mulberry mass.

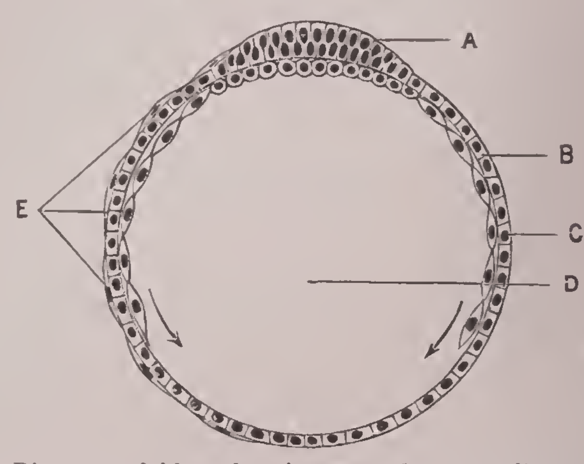


Fig. 7.—Diagram of blastodermic stage of mammalian ovum: A, thickening of primary ectoderm; B, constituting the embryonic area; C, entoderm; D, segmentation cavity; E, remains of cuticular layer of Rauber's cells (after Bonnet).

The *complete* and practically *equal segmentation* of the mammalian ovum results in the production of a hollow sphere, the *blastodermic vesicle*, which in its early stage is composed of two cell-layers, a complete external, and an incomplete inner stratum. Within a limited field known as the *germinal area* the elements composing these layers undergo proliferation, which process results in a marked thickening of the blastoderm. Coincident with these changes a third stratum of cells appears between the outer and the inner layers; these now constitute the cardinal embryonal formative tracts, the *ectoderm*, the *entoderm*, and the *mesoderm*. From the establishment of these *germinal layers* the future history of the embryo consists essentially in the unequal growth and the specialization of these three blastodermic layers.

Viewed from the surface, the *embryonic area* early exhibits an opaque periphery and a clearer central field, the

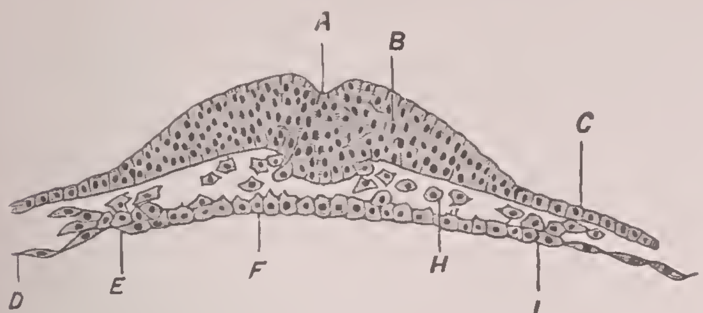


Fig. 8.—Transverse section of embryonic area: *A*, primitive groove in center of area of thickened ectoderm (*B*) which passes on either side into ordinary ectoderm (*C*); *F*, entoderm, that lying between *E* and *I* is devoted to forming lining of intestinal tube, that beyond (*D*) covers vitellus; *H*, mesoderm just appearing (after Bonnet).

area pellucida; likewise, from the caudal pole of the embryonic area there grows forward an opaque centrally situated rod, the *primitive streak*; this is a transient structure which does not form part of the embryo, but which is only the forerunner of the earliest trace of the embryo proper.

Very soon after the formation of the primitive streak the appearance of two diverging V-like folds, which embrace the anterior extremity of the primitive streak, marks the first step in the production of the future animal. These ridges are the *medullary folds*, and the included longitudinal furrow is the *medullary groove*; some time later a rod of cells appears at the bottom of the latter, and is known as the *notochord*, a structure of great importance as defining the position of the future vertebral column, and consequently the *axis* about which the fundamental structures of the embryo are grouped. The medullary folds eventually unite over the medullary groove along the dorsal line, the inclosed canal thus formed being the primitive *neural tube*, which develops into the important cerebro-spinal nervous tract. On either side of the neural tube the tissue of the embryo undergoes cleavage into minute quadrangular segments known as

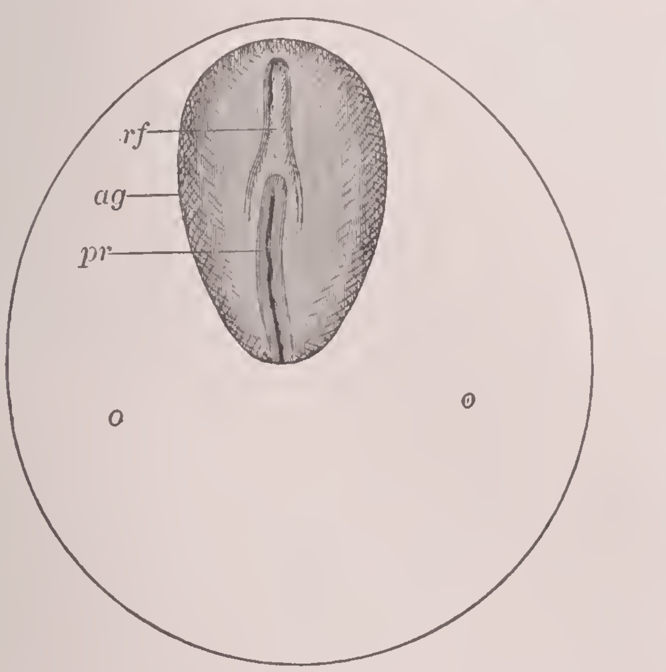


Fig. 9.—Embryonic area of the ovum of a rabbit at the seventh day: *ag*, embryonic area; *o*, *o*, region of the blastodermic vesicle immediately surrounding the embryonic area; *pr*, primitive streak; *rf*, medullary groove (after Kölliker).

the *somites*; these do not accurately correspond with the future vertebræ, but are transient structures, expressive of the earliest manifestation of the law of cleavage into segments characterizing vertebrated animals. With the establishment of these fundamental embryonic structures—the medullary folds, the notochord, and the somites—the formation of the embryo may be considered to be well under way.

While these changes, visible from the exterior, are progressing, important modifications of the blastodermic layers take place within the embryo; one of the most important of these is the cleavage of the great mesodermic tract into two sheets, a *parietal* and a *visceral* layer, which adhere respectively to the ectoderm and to the entoderm. The space included between these two layers of the mesoderm is the primitive *body-cavity*, from which are derived the important spaces containing the abdominal organs, the lungs, and the heart.

The two layers of tissue thus formed by the ectoderm and the parietal sheet of the mesoderm on the one hand, and by the entoderm and the visceral layer of the mesoderm on the other, are actively engaged in forming folds from which the protecting membranes and the body-walls and the walls of the digestive tube and its glandular appendages are respectively produced.

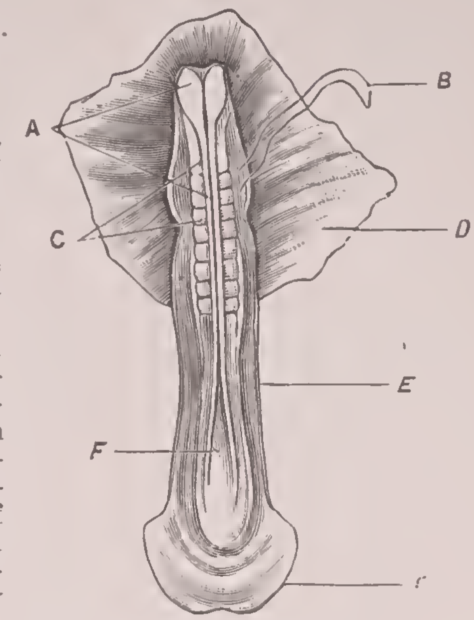


Fig. 10.—Sheep embryo of sixteen days seen from the dorsal surface: *A*, neural plates which inclose the nervous tube; *C*, primary segments or somites; *B*, *E*, portions of amnion; *D*, portions of umbilical vesicle; *F*, allantois (after Bonnet).

These are the general features of the development of the embryo in all vertebrated animals. There are other details which relate to the special growth of particular parts, and to the so-called metamorphoses or transformations which take place in particular species; these are nothing more than the successive appearance and disappearance of particular organs, which are adapted to the life of the animal at different stages of growth. Thus in the young tadpole, when first hatched from the egg, the mouth is a round orifice provided with a suctorial apparatus and adapted for feeding on vegetable matters; respiration is entirely aquatic, and is performed by means of gills; there are no limbs, but voluntary movement is accomplished by a large and muscular tail, the animal living altogether under the surface of the water. Afterward the mouth enlarges into a wide transverse opening, adapted for the seizure of living prey; the gills disappear and lungs are developed, while the mode of respiration changes from aquatic to aërial; and finally, anterior and posterior legs grow from the corresponding parts of the body, becoming powerful organs for both swimming and leaping, while the tail ceases to grow, becomes atrophied, and disappears. Thus the tadpole gradually acquires the organs and the appearance of a perfect frog. This change, in the case of the tadpole, is called a

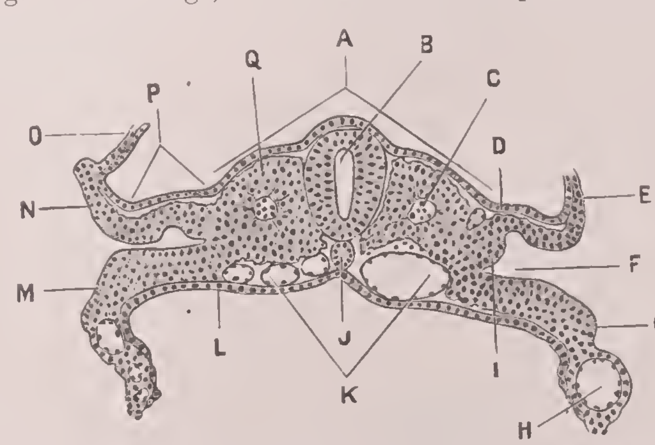


Fig. 11.—Transverse section of sheep embryo of about eighteen days: A, P, axial and parietal embryonic zones; B, neural canal; C, cavity of somites; D, ectoderm passing into amnion (O); E, G, parietal and visceral layers of mesoderm; F, primary body-cavity; H, umbilical vein; I, middle plate; J, notochord; K, primitive aortæ; L, entoderm; M, N, intestinal and abdominal plates forming by their union respectively the wall of the primary gut and of the body-cavity (after Bonnet).

"transformation," because it happens after the young animal has escaped from the egg; but equally important changes take place in the embryo of the higher animals while they are still retained within the egg or in the uterus of the female parent.

Besides the essential and general features of embryonic development detailed above, there are, in all the higher classes, certain secondary or accessory organs developed during embryonic life which will require a further description.

The first of these is known as the *umbilical vesicle.* In the process of development, as already described, the abdominal walls, growing together upon the median line, inclose directly the whole of the vitelline cavity, which subsequently, of course, becomes the cavity of the intestine. But in many of the fishes and reptiles, and in all birds and mammals, the abdominal walls approach each other before they have embraced the whole of the vitellus, so that the vitelline cavity is thus separated, by a kind of constriction, into two parts. The internal part, which is fully embraced by the abdominal walls, is, as before mentioned, the cavity of the intestine; but the external part, which is left by this constriction outside the abdomen, is the umbilical vesicle. This name is given to it because it is really a vesicle, containing some of the remains of the vitellus, and because it still communicates with the cavity of the intestine through the umbilicus or navel. This communication is at first short and wide; but as development proceeds, the umbilical vesicle gradually retreats farther from the abdomen, while the passage of communication becomes converted into a comparatively long and narrow canal. In many mammals and in the human species this canal is partially obliterated at an early period, so that the umbilical vesicle then forms an isolated cavity or sac, connected with the abdomen only by a slender solid pedicle. In the earlier stages blood-vessels run out along this pedicle, and ramify upon the surface of the umbilical vesicle.

Another important accessory organ of the embryo is the *amnion.* This is a delicate and transparent membrane, which turns up from the edges of the body walls over the back of the embryo, and thus envelops it in a secondary cavity called the "sac of the amnion"; the albuminous protective liquid which it contains, and in which the embryo is bathed, is called the "amniotic fluid." The amnion is accordingly an extension of the outer layer of the blastodermic membrane, and is continuous with the integument of the embryo at the umbilical orifice. In other words, the external layer of the blastodermic membrane in these cases develops into two different parts; that which immediately invests the body of the embryo is its integument, while that which turns backward at the edges of the abdominal opening is the amnion, a protective organ of embryonic life. The amnion at first closely embraces the body of the embryo, but afterward it expands more rapidly with the increase of the amniotic fluid, so that the young animal may move freely within its cavity when the muscular system begins to exhibit signs of activity.

The third accessory embryonic organ is the *allantois*, so called from the Greek ἀλλᾶς, ἀλλᾶντος, a "sausage," because of its elongated cylindrical form in some cases. The allantois is an outgrowth from the hind-gut or lower part of the intestine. It shows itself where typically developed, but not in the human embryo, as a small bud or diverticulum, shaped somewhat like the finger of a glove, which protrudes from the abdominal opening in front, and then rapidly expands in every direction until it has entirely enveloped the embryo, as well as the amnion, in a second exterior covering. Later its walls are exceedingly vascular; by the time the allantois has become completely formed, the external surface of the embryonic mass forms a continuous vascular membrane, in which the blood-vessels of the embryo ramify in great abundance.

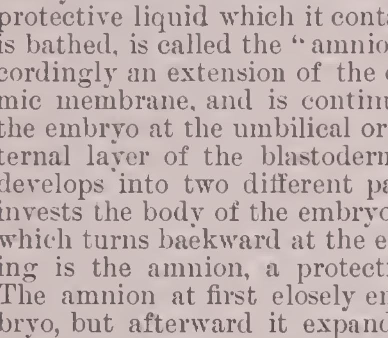


FIG. 12.—Embryo of a chick on the seventh day of incubation: *a*, body of the embryo; *b*, amnion; *c*, a portion of the umbilical vesicle; *d*, commencing growth of the allantois.

This anatomical feature will serve to indicate the usefulness and the function of the allantois. It is the organ of nourishment and respiration for the embryo. In the fowl's egg the allantois, which is placed immediately underneath the calcareous shell and shell-membranes, is very active during the latter half of the period of incubation. It absorbs oxygen from the external air through the porous egg-shell, and exhales carbonic acid, thus serving to renovate and arterialize the blood as the lungs will do in the young chick after being hatched. In mammals the allantois is still more important. The ovum in these animals being of minute size, without any abundant store of nutritious material, and being retained, after fecundation, within the body of the female parent, the young embryo is entirely dependent upon the maternal system both for respiration and nourishment. The vascular allantois here, enveloping the embryo, comes in contact with the vascular lining membrane of the uterus, and thus the blood-vessels of the embryo constantly absorb from the blood-vessels of the mother the substances requisite for its nourishment and growth. In many kinds of animals the allantois even contracts a more or less intimate adhesion with the lining membrane of the uterus at particular spots, resulting in the formation of the *placenta*, where the process of absorption and transudation is carried on with greater rapidity.

In the human species the allantois commences its growth in the same manner as in the inferior animals, but very soon exhibits certain modifications in its subsequent development. In man the allantois never exists as a free sac, but grows out largely as a solid structure which early participates in the formation of a continuous vascular envelope, the *chorion.*

The human chorion at an early period becomes shaggy or velvety by the growth of a multitude of minute filamentous projections or *villi* upon its outer surface. These projections become branched and divided, forming so many tufted filaments, which greatly favor absorption. Soon after the first month, however, the villi cease their growth over about three-quarters of the surface of the chorion, which parts thus become smooth and bald; while over the remaining quarter they grow more rapidly than before, be-

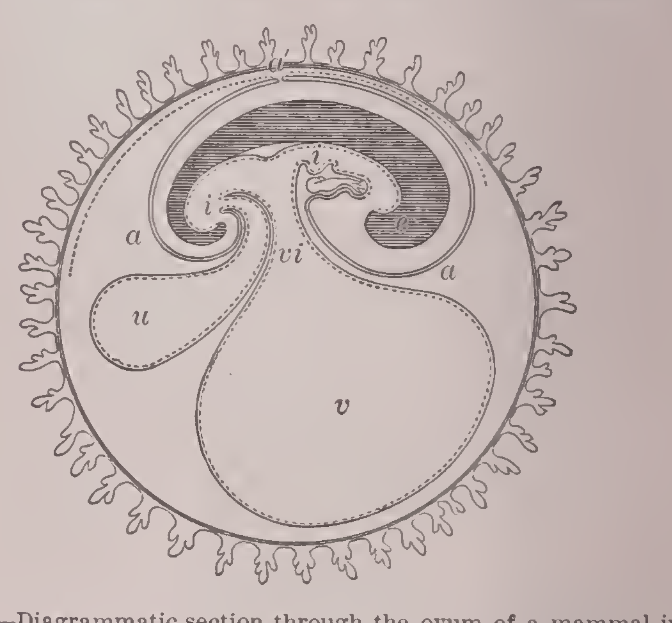


Fig. 13.—Diagrammatic section through the ovum of a mammal in the long axis of the embryo: *e*, the cranio-vertebral axis; *i i*, the cephalic and caudal portions of the primitive alimentary canal; *a*, the amnion; *a'*, the point of reflection into the false amnion; *v*, yolk-sac, communicating with the middle part of the intestine by *vi*, the vitello-intestinal duct; *u*, the allantois. The ovum is surrounded externally by the villous chorion.

coming excessively developed both in numbers and in ramification and vascularity, so that the chorion here becomes converted into a thickened and spongy mass, penetrated everywhere with an abundance of looped and ramifying blood-vessels. The union of this portion of the chorion with the maternal tissues of the uterine walls when fully developed forms a distinct organ, the *placenta.* The placenta, accordingly, is the special organ of nourishment for the embryo. It has become well developed and easily distinguishable from the remaining portions of the chorion by the end of the third month of embryonic life.

The amnion and the chorion, although termed "membranes" and "appendages," are in reality connected with the body of the embryo. The placenta includes also a portion of the tissues of the mother; for at the same time that the chorion is becoming excessively shaggy and vascular at the spot at which is afterward to be the placenta, the lining membrane of the uterus also assumes, at the corresponding point, a similar increased development. In both cases the blood-vessels preponderate over the remaining tissues, the existing maternal vascular channels especially becoming enormously enlarged and intimately united with the fœtal constituents of the placenta—the vascular villi of the chorion. Thus the placenta, when fully formed, is a double organ, containing both embryonic and maternal vessels, presenting an extensive vascular surface for reciprocal absorption and exudation. At no time is there an actual communication between the lumen of the two sets of vessels, the nutritive interchanges taking place through the interposed thin vascular walls.

Certain conditions result in the production of multiple births, of which twins are the most common example. The average ratio of twin births, taken from the statistics of the civilized world, is about one in every hundred. In Bohemia twins occur once in every sixty births; in Prussia they occur once in every eighty-eight; in France, once in every hundred; and in New York, once in every 120. Triplets occur once in 7,910, and quadruplets only once in 371,126 births. About a dozen well-authenticated cases of the birth of five children at one time are recorded in medical literature, and even a single, apparently trustworthy, case of the birth of six—two girls and four boys—has been recorded in Italy. The reputed births in excess of this number are apocryphal. Extended observations regarding twins show that in one-third of the cases both children were boys; in not quite one-third both were girls; and in the remaining third both sexes were represented. The occurrence of twins depends upon the simultaneous development of two germs; these are usually contained within two distinct ova, liberated from the ovary at the same time, but in a little over 10 per cent. of the cases studied the two germs are contained within the same ovum, which is then spoken of as "double-germed." Twins derived from a single ovum are always of the same sex.

In the formation of their attachments to the maternal structures, as already above described in connection with the placenta, the nutritive areas of the two children become very closely associated, often to the degree of direct communication between their circulations within the placentæ. When such close relations have been established, marked inequality in the vigor of the developing beings may seriously affect the weaker fœtus in consequence of the appropriation of an undue share of the sources of nutrition by its stronger brother. Triplets, likewise, may originate from three distinct ova, or from two ova, one of which was double-germed; as rare possibilities, in both twins and triplets, the division of a germ primarily single may be assumed.

The phenomena attending the menstrual epochs mark the periodic changes taking place within the uterine cavity in the preparation of the mucous membrane for the reception of the ovum should impregnation occur; in such event, the egg passes from the oviduct into the uterus, the recesses of whose soft velvety lining offer especially favorable situations for the retention and growth of the developing ovum. In addition to its important contribution to the placenta, the thickened uterine mucous membrane, known as the *decidua*, very early, long before the placenta is formed, becomes elevated around the arrested ovum, which is soon completely inclosed within a special sac formed by the extension of the uterine lining, the *decidua reflexa*.

When the development of the embryo is completed the muscular walls of the uterus contract, the membranes are ruptured, and the fœtus is expelled; subsequently the placenta or afterbirth is separated from its attachments and cast from the uterine cavity, having ceased to be an available nutritive organ. After birth the act of respiration and the absorption of nourishment are accomplished in the infant independently by the aid of internal organs (the lungs and the digestive tract), thus replacing the means of nourishment which during embryonic life were supplied by the placenta from the blood of the mother.

Revised by G. A. PIERSOL.

Embryology (in plants): Every plant, however simple or complex it may be, develops from a single (egg) cell. In simple plants the successive changes from the first cell to the adult organism are few, and the embryological history is brief, but, with the increasing complexity of the full-grown plant, the history of its development is much prolonged. Thus in the Protophytes, the reproductive cell, always asexual, merely divides into two cells, and after a period of growth these divide again, and so on. The cells so produced may separate from one another at once, as in *Chroococcaceæ*, or they may remain more or less firmly attached in a filament, as in *Nostoc*, *Oscillaria*, etc. (Fig. 1).

Many Phycophytes have an equally simple developmental history. In those in which the mature plant-body is a plane, or a mass of cells, there is first the formation of a filament, which gives rise to a plane or mass by the division, in two or more directions, of an end cell and its daughter cells (Fig. 2). The egg-cell here is one produced by a sexual process, but a similar development takes place in many cases from asexually produced cells.

The lower Carpophytes are simple rows of cells whose development is similar to that of the filamentous Protophytes and Phycophytes. In fact this is the case with most of the fungi, whose simple plant-bodies develop from the single spore, practically as in the case of the filamentous algæ. It must be borne in mind that in the case of an ordinary fungus what is popularly called the plant is in fact the "fruit," while the proper plant-body consists of slender branching filaments with little or no coherence. Thus a toadstool is the relatively large "fruit" of a mass of white filaments which grow in decaying organic matter. In the Red Seaweeds the spore soon elongates and subdivides, giving rise to a simple structure which eventually becomes more complex.

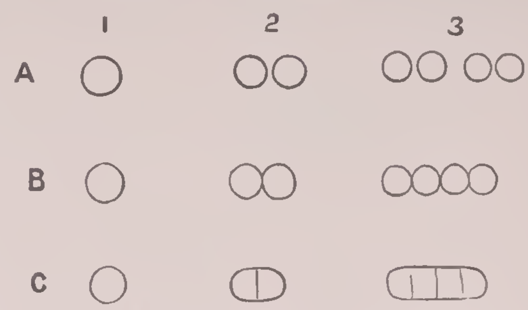


FIG. 1.—Diagrammatic representations of young stages of Protophytes: A, the cells all soon separating; B, the cells slightly cohering; C, the cells permanently cohering (1, the first cell; 2, after first division; 3, after second division).

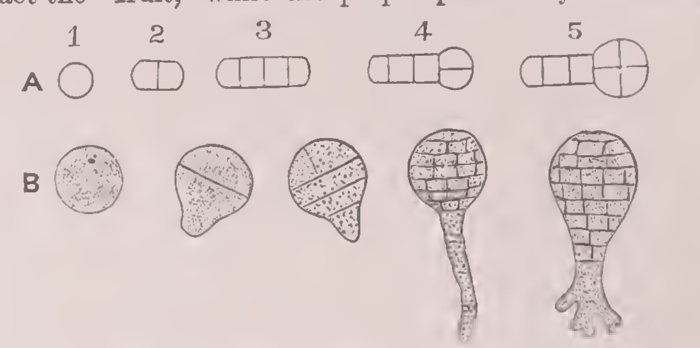


FIG. 2.—A, an ideal development of a young Phycophyte; B, actual development of a young Rockweed (*Fucus vesiculosus*).

In the nearly related Stoneworts (*Charophyceæ*) when the spore germinates it produces first a slender row of cells, the pro-embryo, which after a considerable growth produces at its apex a cluster of rudimentary leaves. Above this the structure approaches that of the mature plant. Among the Mosses we find a considerably prolonged embryonic life preceding the sexual generation. The spore upon germinating gives rise to a branching filamentous growth, known as the protonema, but in reality the young state of the moss plant. After a time leafy branches arise upon these threads (Fig. 4).

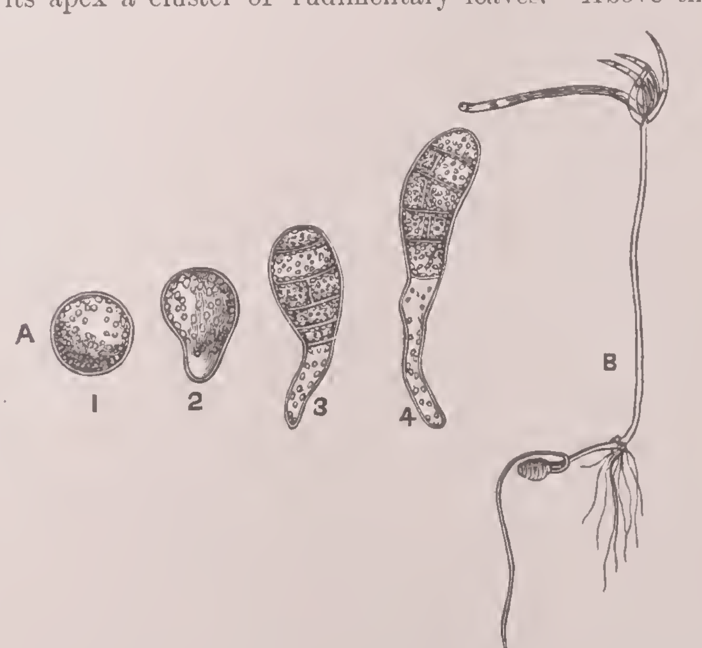


FIG. 3.—A, development of a young Red Seaweed (*Polysiphonia*) from an asexually produced cell (1); B, young Stonewort (*Chara*) developed from asexually produced cell (egg-cell).

The asexual generation develops from the fertilized egg-cell much more directly, but still there is a distinct embryonic stage, consisting of an elongated mass of growing cells (Fig. 4). This eventually develops into the stalked sporocarp with its complex structure.

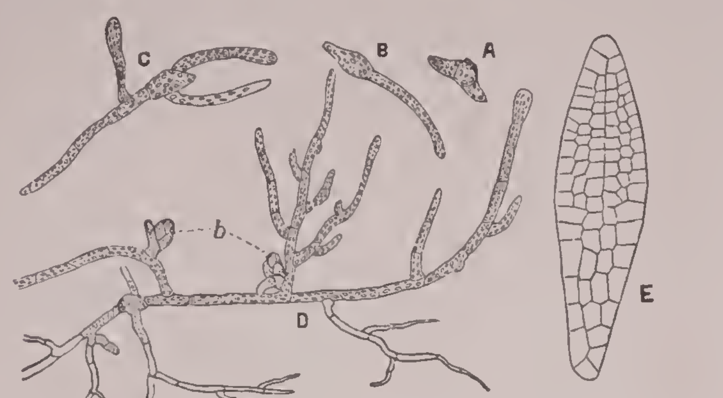


FIG. 4.—A, a spore of a moss (*Funaria hygrometrica*) beginning to germinate; B and C, germination further advanced; D, protonema with two buds (at *b*), from which leafy shoots will grow; E, embryo of asexual plant of the same moss.

In the Fernworts upon the germination of the spore a succession of embryonic stages is passed before the sexual plant attains its adult form (Fig. 5, A). The asexual plant develops quickly from the fertilized egg-cell by a series of divisions which give rise to a rounded embryo (Fig. 5, B) consisting of eight cells, from one of which develops the stem, from another the cotyledon, from still another the root, while one produces a temporary structure, the foot (an organ of suction which remains in the archegone). In the Gymnosperms the sexual generation is still a mass of tissue of considerable size, but as compared with the prothallium of ferns or the oöphore of Bryophytes it must be regarded as embryonic. It develops from the macrospore (embryo-sac) by continued subdivision, resulting in an ovoid

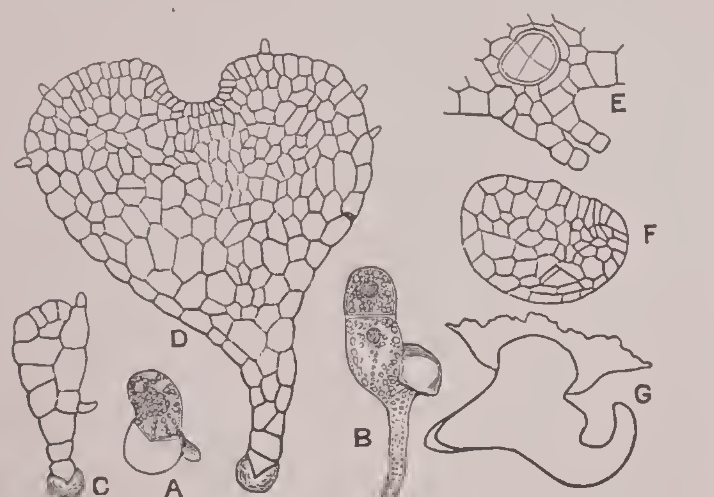


FIG. 5.—A to D, development of the sexual plant of the ferns from an asexually produced spore; E to G, development of the asexual plant from the egg-cell.

mass of parenchymatous cells (Fig. 6). The asexual generation in the Pines develops from the fertilized egg-cell (oöspore) by the subdivision of the latter, resulting in the formation of several long, tortuous filaments, the free ends of which give rise to cell-masses, one of which increases in size, becomes cylindrical, and eventually produces a whorl of leaves (the cotyledons) at one end and the primary root at the other. After the young plant is free from the seed-coats its successive nodes produce more perfectly formed leaves, while the structure of the stem becomes more complex.

In Angiosperms the sexual generation (oöphore) is still more rudimentary than in Gymnosperms, and it undergoes this interesting modification, that its development is actually delayed until after the egg-cell is fertilized, when the two generations, oöphore and sporophore, develop simultaneously. Before this the oöphore is represented by little more than the egg-cell (oösphere), but after the fertilization of the latter the macrospore (embryo-sac) develops a mass of tissue similar to that in the Gymnosperms, and which persists in some seeds, as endosperm.

The asexual generation (sporophore) develops from the fertilized egg-cell by a series of subdivisions, resulting in the production first of a row of more or less elongated cells, the so-called "suspensor." The cell at the free end of the suspensor ultimately subdivides again and again, and eventually forms a short stem, with one or two rudimentary leaves

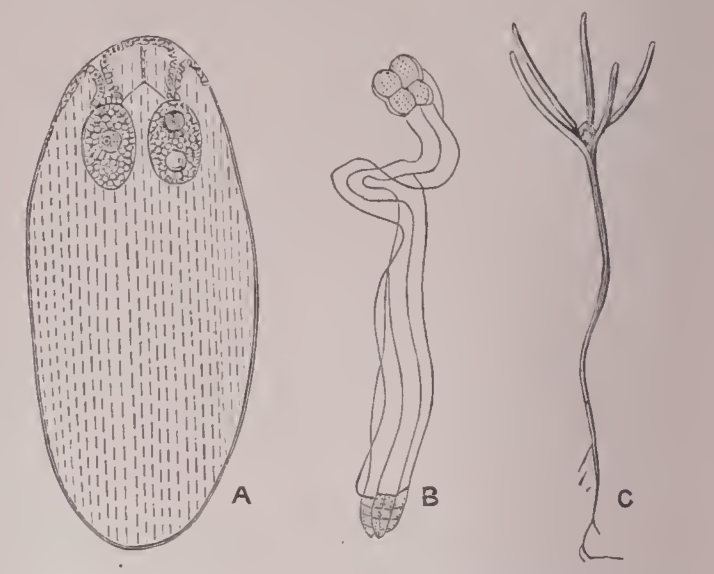


FIG. 6.—A, the sexual plant (prothallium) in the ovule of a pine, bearing the young egg-cells at its summit; B, very young stage of the asexual generation of the pine; C, the same, much later, after its escape from the seed.

(the cotyledons). The suspensor cells make no further growth, but the embryo proper may grow less or more, according to the plant under consideration. In all cases the embryo is surrounded and nourished by the endosperm (oöphore, or prothallium). Where this nourishment of the embryo is prolonged, the embryo is large, and the endosperm is correspondingly small, or it may have entirely disappeared. We have thus the technical distinction of seeds with endosperm (albuminous), and without endosperm (exalbuminous). See ENDOSPERM.

The young plant upon emerging from the seed in germination has root, stem, and leaves, but these are yet of much simpler structure than in the adult plant. This is well seen in the leaves which appear successively upon the stem, the earlier ones differing much from the later. In compound-leaved plants the earlier leaves are simple, and even the first compound leaves are smaller and simpler than those which follow.

This brief sketch of plant embryology is all that can be given here. It will serve to show that in all plants the beginning is a single cell, and that the development of the

FIG. 7.—Stages in the development of a Dicotyledon (*Orobus angustifolius*): A, fertilized egg-cell in the summit of the embryo-sac; B, egg-cell divided once; C D E, further division; F, embryo in embryo-sac; G H I K M, subsequent stages; J, young embryo of *O. aureus*; L, young embryo of pea (all highly magnified).

individual is from the simple to the complex. All plants travel a greater or less distance over what appears to be the same road; some (the higher plants) go farther, others (the lower plants) go a shorter distance.

LITERATURE.—W. Hofmeister, *The Germination, Development, and Fructification of the Higher Cryptogamia, and the Fructification of the Coniferæ* (1862); J. Hanstein, *Die Entwickelung des Keimes des Monocotylen und Dicotylen* (1870); F. Hagelmaier, *Vergleichende Untersuchungen über Entwickelung dicotyledonen Keime* (1878); E. Strasburger, *Ueber Befruchting und Zelltheilung* (1878); J. Vesque, *Développement du Sac Embryonnaire des Phanerogames Angiospermes* (1878–79); E. Guignard, *Recherches d'Embryogénie Végétale Comparée* (1881–92).

D. H. Campbell has studied the embryology of many Pteridoptytes 1885–92 (*Bot. Gazette, Am. Naturalist, Annals of Botany*).

CHARLES E. BESSEY.

Embury, Philip: the "founder of American Methodism"; b. at Ballygaran, Ireland, Sept. 21, 1729. He became a member and "local preacher" of Wesley's society at Court-Mattress in 1758. In 1760 he emigrated to New York. At the suggestion of his cousin, Barbara Heck, he began to preach there in 1766 in his own house, mostly to his own countrymen. Later he preached in an old rigging-loft, and at last (1768) erected a chapel on the site of the present "Old John Street church." Embury, who was a carpenter, worked on it himself. He built its pulpit, and on Oct. 30, 1768, preached from it the dedicatory sermon of the humble structure—the first Methodist chapel of the New World. Embury settled in Camden, Washington co., N. Y., in 1769, where also he founded his denomination, and where it grew into the prosperous Troy Conference. D. at Camden in Aug., 1775. In 1866 his remains were removed to Cambridge, N. Y., where in 1873 a monument to his memory was unveiled.

Emden: seaport-town of Hanover, Prussia; on the north shore of the Dollart, near the mouth of the Ems, about 70 miles W. N. W. of Bremen (see map of German Empire, ref. 3–D). It is intersected by several canals, which are crossed by about thirty bridges. It is well built, and contains a handsome town-hall, an exchange, a custom-house, a gymnasium, a school of navigation, and an asylum for deaf and dumb. Here are manufactures of linen fabrics, hosiery, hats, sail-cloth, starch, soap, etc. The port of Emden has shallow harbors, outer and inner, but the roadstead is deep enough for large ships. Pop. (1890) 13,695.

Emerald [O. Fr. *esmeraude* < Lat. *smaragdus* = Gr. *σμάραγδος*]: a green precious stone, really a variety of Beryl (*q. v.*), owing its exquisite color to the presence of a small amount of oxide of chromium. The crystals are six-sided prisms, usually with flat terminations. The value depends chiefly upon the depth of color; a fine gem has been sold for $12,500, coming next in price to the diamond, and often old and poorly cut stones when recut gain decidedly in beauty and value. The largest emeralds are found at Takowaja, in the Urals; one in the cabinet of the Imperial Mining School at St. Petersburg weighs 6¾ lb. troy. Most of the modern emeralds come from Muzo in the United States of Colombia, but they are also found in other localities in South America, in the Orient, and in the Henbach valley, near Salzburg. The mines at Mt. Zaborah, in Upper Egypt, where the ancients obtained many emeralds, were rediscovered in 1818 by M. Cailliand. These emeralds were used in trade with the Persians, who in turn gave lapis lazuli. Vegetable Creek, New South Wales, has yielded beautiful specimens, and in the U. S. handsome crystals of light color up to 8 inches in length, only partly transparent, have been found in Alexander co., N. C. The Romans used to polish emeralds on the six faces of the natural prism, without reshaping them, and these are known as *prime emeralds*. The gem was well known and greatly esteemed among the ancients. Oriental emerald is a green variety of sapphire, or Corundum (*q. v.*). Emerald copper is a name for diopside, a phosphate of copper, as emerald nickel is for zaratite, a hydrated carbonate of nickel. Both are beautiful minerals, but are not used as gems. George F. Kunz.

Emerald Bird of Paradise: the best known and most elegant of the birds of paradise; a native of the Aru islands, W. of New Guinea (Papua), where it is killed in great numbers for its beautiful plumage, which brings a high price in the market. It receives its systematic name, *Paradisea apoda* or the "footless" bird of paradise, from the old fable that the bird of paradise has no feet, but always flies without resting.


Emerald bird of paradise.

The skins with the plumage are used in the East for ornamenting turbans, and in Europe and America for adorning ladies' head-dress. Several thousands are annually imported into Europe, chiefly by way of Batavia. The back part of the neck is of a pale-gold color, the throat and fore part of the richest changeable golden green, the breast a deep purplish brown, the body and tail a fine chestnut. The female lacks the long floating flank plumes of the male, and is generally less highly colored and smaller than the male.

Emerald Green: See Schweinfurth Green.

Emersion [from Lat. *emer'gere*, emerge]: in astronomy, the reappearance of the sun, moon, planet, or star from behind the celestial body by which it was hidden in an eclipse or occultation. The phenomena of immersion and emersion, especially of Jupiter's first satellite, are useful in determining the longitude of places.

Emerson: town of Canada: on the boundary-line between Minnesota and Manitoba; 66 miles S. of Winnipeg; the terminus of the Emerson Branch of the Canadian Pacific Railway (see map of Canada, ref. 9–H). Pop. 1,500.

Emerson, Alfred, A. M., Ph. D.: archæologist; b. at Greencastle, Pa., Feb. 25, 1859; educated in Germany and at Johns Hopkins University. Since 1891 he has been associate Professor of Classical Archæology, Cornell University, and contributing editor of the *American Journal of Archæology*. He has published *Dissertatio de Hercule Homerico* (Munich, 1881) and several monographs.

Emerson, Ralph Waldo, LL. D.: poet and essayist; b. in Boston, Mass., May 25, 1803; fourth in the order of birth of the eight children of Rev. William Emerson and Ruth (Haskins) Emerson. He had a minister for an ancestor in every one of eight generations back, either on the paternal or maternal side. He was fitted for college at the public schools of Boston, and graduated at Harvard College in 1821. He was not among the very highest scholars of his class, but in his junior year won a Bowdoin prize for a dissertation on the *Character of Socrates*, and another in his senior year for an essay on *The Present State of Ethical Philosophy*. He also won a Boylston prize for declamation, and he was class poet. For five years after leaving college he taught school, chiefly in Boston, where he assisted his elder brother, William, in conducting a successful school for girls. In 1826 he was "approbated to preach," though his name does not appear among the graduates of the Harvard Theological School. In Mar., 1829, he was ordained as colleague to Rev. Henry Ware of the Second Unitarian church in Boston. In 1832 he resigned his pastoral charge, having announced in a sermon his unwillingness longer to administer the rite of the Lord's Supper. In Dec., 1832, he sailed for Europe, remaining absent nearly a year, and during his visit made the acquaintance of Carlyle. Two years later a correspondence sprang up between them, and continued until Carlyle's death. Soon after returning he began his career as a lecturer before the Boston Mechanics' Institute, his subject being *Water*. He gave also three other lectures—two on *Italy* and one on the *Relation of Man to the Globe*. In 1834 he gave in Boston a series of biographical lectures on Michael Angelo, Milton, Luther, George Fox, and Edmund Burke, the first two of which were published in the *North American Review*. After that time he gave many courses of lectures in Boston, and became one of the best-known lecturers throughout the U. S. It is said that he lectured for forty successive seasons before the Salem (Mass.) Lyceum. He also made repeated lecturing tours in the Western States, and even lectured in California and in Great Britain.

In 1835 Mr. Emerson took up his residence in Concord, Mass., and published in the following year a thin volume called *Nature*. It marked a new era in American thought—was received with sharp criticism from many quarters, and with corresponding enthusiasm by a small circle of admirers. It took twelve years to sell 500 copies. This was followed by several orations before literary societies on such themes as *The Method of Nature*, *Man Thinking*, and *Literary Ethics*. More important even than these was his remarkable *Address before the Senior Class at Divinity College, Cambridge*, delivered July 15, 1838. From these various addresses and publications may be dated the intellectual movement then vaguely stigmatized as *Transcendentalism*. This was a reaction against formalism and tradition, and brought together a variety of minds, some profoundly mystical, others full of projects for action. It led to some excesses and affectations, but was on the whole a valuable impulse toward many good things. The four volumes of *The Dial* contain a lasting memorial of that important seed-time of thought.

Mr. Emerson's *Essays* were collected and published in two volumes in 1841 and 1844, and his *Poems* in 1846. His miscellaneous addresses remained uncollected till 1849, in the U. S., though they had been reprinted collectively in England in 1844. Visiting the mother country in 1847, Mr. Emerson found awaiting him a large circle of admirers, whose allegiance he always retained. In 1850 he published *Representative Men*, given previously as a course of lectures in Boston. In 1852 he took part in preparing the memoirs of Margaret Fuller Ossoli. His *English Traits* appeared in 1856, *The Conduct of Life* in 1860, and *May-Day and other Poems*, and *Society and Solitude* in 1869.

Though Mr. Emerson is often assigned to the class of metaphysicians or "philosophers," yet the actual traits of his intellect clearly rank him rather among poets or literary men. All his methods were literary rather than scientific, although he won some of his warmest admirers among scientific men, as in the case of Prof. Tyndall. His statements are sometimes subtle, sometimes profound, sometimes noble and heroic, but scarcely ever systematic. He rested in his intuitions, rarely attempted even the rudiments of method, but constantly recognized, in his own words, "the opposite negations between which, as with cords, our being is swung."

In viewing Mr. Emerson simply as a literary artist, the reader must still complain of this tantalizing fragmentariness, this disregard of all the unities, this structural defect. Even in his poems his genius is like an æolian harp that now gives, now willfully withholds, its music; while some of his essays seem merely accidental collections of loose leaves from a note-book. Yet as one makes this criticism, one is shamed into silence by remembering many a passage of prose and verse so majestic in thought and rhythm, of quality so rare and utterance so delicious, as to form a permanent addition to the highest literature of the human race.

Mr. Emerson wrote in 1844 that all the books read in the U. S. were European, that "we are sent to a feudal school to learn democracy"; and demanded that his fellow-countrymen should advance out of all hearing of others' censures, out of all regrets of their own, into a new and more excellent social state. More than any previous literary man, he set the example of ignoring European traditions, methods, and literary properties wherever these could be better superseded by home products. He drew his habitual illustrations from the society and manners of the U. S., and was more ready to write of the pine woods and the humble-bee than of the nightingale and asphodel. It seems hardly credible that this should have been ridiculed by the critics as "a foolish affectation of the familiar"; but the fact of the ridicule shows the need of the innovation. If that state of things has now passed by, and if the literature of the U. S. is no longer provincial, it is to Mr. Emerson that it is most indebted.

It is well known that his position on religious questions was that of a philosophical radical, and that he became entirely detached from the church organizations of the time. He took this position, once for all, in a sentence which attracted much attention in his *Divinity Hall Address*: "The assumption that the age of inspiration is past, that the Bible is closed, the fear of degrading the character of Jesus by representing him as a man, indicate with sufficient clearness the falsehood of our theology." His precise attitude as to the conception of a Deity and the belief in personal immortality might be harder to define. He declares eloquently, however, in one of his orations, that "there is a sublime and friendly Destiny by which the human race is guided—the race never dying, the individual never spared—to results affecting masses and ages."

Though Mr. Emerson was, like Goethe, a prophet of Self-Culture, he never held himself aloof, like Goethe, from the immediate public agitations of his time, but always practically recognized the truth of his own formula, "To-day is a king in disguise." He always lent his voice in behalf of any momentous public interest. He was always frankly identified with the anti-slavery movement, and, though averse to extemporaneous speech, and ill at ease in that form of service, he often took part in the meetings of the abolitionists. In 1844 he gave an elaborate and remarkable address on the anniversary of emancipation in the British West Indies. He signed, with his wife, the call for the first National Woman's Rights Convention in 1850. He was a vice-president of the Free Religious Association, and several times addressed its conventions. He was also an overseer of Harvard University, and received from that institution the degree of doctor of laws in 1866. He was a member of the American Academy of Arts and Sciences, of the American Philosophical Society, and of the Massachusetts Historical Society.

Mr. Emerson was twice married—in 1829, to Ellen Louisa Tucker, of Concord, N. H., who died in 1831; and in 1835, to Lidian Jackson, of Plymouth. He had three children, two daughters and one son. The son, Edward Waldo, graduated at Harvard College in 1866, and afterward pursued the study of medicine. Ralph Waldo Emerson died at Concord, Apr. 27, 1882. See his authorized *Life* by J. Elliot Cabot (2 vols., 1887); also biographies by O. W. Holmes, George W. Cooke, Richard Garnett, and Alexander Ireland; Conway's *Emerson Abroad and at Home*; *The Genius and Character of Emerson*, edited by F. B. Sanborn; E. B. Emerson, *Emerson in Concord*; D. G. Haskins, *Emerson's Maternal Ancestors*; *Correspondence between Carlyle and Emerson*, edited by C. E. Norton. T. W. HIGGINSON.

Emerton, EPHRAIM: professor of history; b. Feb. 18, 1851, at Salem, Mass.; educated at the public schools, and graduated at Harvard College in 1871. He spent two years in journalism and the study of law, and was in Europe 1873–76, spending two years at the universities of Berlin and Leipzig, from the latter of which he received (1876) the degree Ph. D. In 1876 he became instructor in History at Harvard, and in 1882 received the appointment of Professor of Ecclesiastical History. He has published *Synopsis of the History of Continental Europe*; *The Study of Church History*; *Sir William Temple und die triplealliance vom jahre 1668*; *The Practical Method in Higher Historical Instruction* (in *Methods of Teaching History*, ed. by G. Stanley Hall, 2d ed. 1885); *An Introduction to the Study of Mediæval History* (1888–93).

Emery [from Fr. *émeri* < O. Fr. *esmeril* < Lat. **smiri'lis*, from Gr. σμῖρις, σμῆρις, a polishing powder]: one of the hardest minerals known, ranking next to the diamond in its power of cutting or abrading hard substances. It is a variety of the species corundum or sapphire, of a dark reddish-brown, black, or gray color, and consists of nearly pure alumina and oxide of iron. Sapphire contains $97\frac{1}{2}$ per cent. of alumina, and corundum about 92 per cent. The percentage in emery ranges from 60 to 78, with 25 to 35 per cent. of oxide of iron, and a few per cent. of silica and of water. Emery is found in large masses, and much resembles fine-grained iron ore, for which it has often been mistaken. It is obtained chiefly from Asia Minor and the island of Naxos in the Grecian Archipelago. The chief supply of foreign emery in the U. S. comes from Turkey, about 70 miles from the port of Smyrna, where it costs about $22 per ton. It has also been found at Chester, Mass., where it was at one time mined. A better quality of stone, properly called corundum, but serving the same economic purposes as emery, has been found in Georgia and the Carolinas, and an important industry has sprung up in Rabun co., Ga., and Macon co., N. C. The production in 1890 was 1,970 tons, valued at $89,395. In the same year imports of crude rock amounted to 3,867 tons, valued at $97,939, and crushed rock to 534,968 pounds, valued at $20,382.

Emery is scarcely inferior to the sapphire or ruby in hardness, and it will not only cut the hardest steel or chilled castings, but will wear away quartz, agate, topaz, and other gems, being for the last-named purpose the chief reliance of the lapidary. It was used by the ancients for cutting gems. Dioscorides mentions it under the name of *smyris* as the stone with which engraved gems are polished; and there is even a rabbinical tradition which indicates that the "smyris" was used for gem-engraving in the time of Moses. How far it was known and used in prehistoric times must be left to conjecture, but the many neatly cut and polished stone implements and ornaments indicate the use of a material not less hard than emery. Theophrastus mentions whetstones made of the mineral used to engrave gems, and mentions Armenia as furnishing the best kind. Naxian whetstones are also mentioned by ancient authors, and Pliny speaks of polishing marble statues and *filing down* gems. The backs of antique intagli have deep furrows upon them, indicating that they were *filed* into shape by rubbing with an emery-stone. It is thus probable that the massive emery was extensively used as a tool, and that it was employed for the sculpture of hard rocks, not only by the Romans, but by the ancient Egyptians.

It is now used in the arts in a pulverized form, being obtained in grains or in powders of various degrees of fineness by crushing and sifting or by elutriation. The lumps, as they come from the mine, are broken in a breaker or under stamps, and the fragments are sifted through sieves or wire-cloth having from sixty to ninety wires to the inch, by which the grades of the emery are determined. Thus a sieve of sixty wires to the inch gives a No. 60 grade. The numbers range as high as 120, or "flour emery." These higher numbers are obtained by washing, or by collecting the fine dust which floats in the air of the crushing-rooms and settles on the beams and shelves.

There is considerable difference in the effective abrasive power of commercial emery from different localities. It varies according to the composition, the state of aggregation, and the purity. The better qualities of crystalline corundum are believed to be superior to emery in abrasive powers, and powdered sapphire to be superior to corundum, although the experiments which are cited in support of this view are by no means as complete and conclusive as they should be.

The methods of application are various. Lapidaries sprinkle it with water or oil on their lead-wheels. Mixed with glue or other adhesive substances, it is spread in a thin layer upon wood, leather, paper, or cloth, or it is molded into solid blocks or wheels. It is in the latter form, known as "solid emery-wheels," that the mineral has the widest application and its greatest utility.

Emery-wheels.—Solid wheels, consisting of a mixture of powdered emery with shellac, or other substances of similar character, fused and rolled upon a stick, appear to have originated with the lapidaries of India. Small wheels of a few inches only in diameter have been in common use for many years, especially by dentists for shaping hard porcelain teeth, but they are now made by improved methods from 1 to 36 inches in diameter, and from ¼ of an inch to 4 inches in thickness. When carefully mounted upon a mandrel and run at a high speed, the abrading power of such wheels is wonderful. They will instantly take the teeth off the hardest file and reduce it to a plane, smooth surface, or will cut away parts of chilled castings that a file will not touch. Such wheels are shaping-tools of the first order, as far exceeding files in efficacy as the emery exceeds steel in hardness, and as the velocity of a wheel exceeds the velocity of a file upon the work. A file in the hands of an expert workman moves, say, 60 feet in a minute, but the proper velocity of an emery-wheel at its cutting surface is 5,500 feet in a minute. Corundum is also used for wheels.

The rapidity of abrasion depends not only on the velocity of movement, but upon the size of the grains of emery. For very heavy work, such as taking the rough edges off castings, very coarse emery is used, while the finer sorts are made into wheels for fine grinding and surface-work on brass or steel. The following table shows approximately the cuts of emery as compared with files. The numbers represent the standard grades of emery:

8–10	represents	the cut	of a	wood rasp.
16–20	"	"	"	rough file.
24–30	"	"	"	middle-cut file.
36–40	"	"	"	bastard file.
46–60	"	"	"	second-cut file.
70–80	"	"	"	smooth file.
90–100	"	"	"	superfine file.
120-flour emery		"	"	dead-smooth file.

In using emery-wheels care must be taken to maintain the proper speed, and not to press the work too strongly against the surface. If too much pressure is used, the wheels will not cut so fast, and are liable to wear away unequally and to get out of true. A rest should always be used to support the work and prevent it from vibrating upon the wheel. The bearings should be kept in good order and well lubricated.

Good emery-wheels are uniform in texture. The material with which the emery is combined must have great cohesive strength to resist the tendency of the wheels to fly asunder when revolving at high speed, and to retain the grains of emery firmly, and yet wear away evenly, leaving the cutting angles exposed, and not glaze or "gum up." It must not soften or melt under the heat generated by the friction in cutting the work, and must be free from noxious qualities. As such wheels are run at high velocities, they require to be very carefully and exactly hung, and to be kept perfectly true, so as to prevent vibrations. They should not "wedge" upon the mandrel, or even fit it closely, for expansion by heat might burst the wheel, and the flanges at the side should not be too strongly screwed up. A wheel 36 inches in diameter may have 600 revolutions per minute, and one of 12 inches 1,800 revolutions. Although the emery is extremely hard, diamonds will cut the wheels, and this gem in its crude or rough form is used as a tool to turn them true or to cut their faces into desired form. See CORUNDUM.

Revised by G. K. GILBERT.

Emery, STEPHEN A.: See the Appendix.

Emetic [from Gr. ἐμετικός, causing vomiting, deriv. of ἐμέειν, vomit]: a medicine capable of causing the stomach to contract and discharge its contents through the œsophagus. Emetics are of two classes: (1) those which directly irritate the stomach and produce emesis, and (2) those which act on the nerve-centers with like result. Of the former, mustard and alum are examples; of the latter, ipecac and tartar emetic. Emetics are useful to remove irritating food or poisons from the stomach, to cause dislodgement of foreign bodies or croupous membrane from the air-passages, and as a revulsant. The mechanical emetics are always safer than those acting on the nervous system.

WILLIAM PEPPER.

Emeu: See EMU.

Emigration [from Lat. *emigra'tio*, deriv. of *emigra're*, *e*, out + *migra're*, migrate]: the transference of permanent abode from one country to another. Removal into a country is specifically designated as *immigration*; it of course presupposes emigration. See CRUSADES, EXODUS, and MIGRATION.

Whatever view is taken of the origin of mankind, it is evident that the earth must have been almost wholly peopled by numerous emigrations. The story of the wanderings of tribes and races constitutes the chief part of the traditions of the nations of antiquity. A complete record of emigration would amount to a synopsis of the early history of almost every considerable nation of ancient and modern times. The movements of the Aryan and Semitic races took place on a large scale, leaving everywhere their traces in languages, customs, and religions. Among the first of recorded emigrations, though of doubtful date, was that led by the Hyksos or Shepherd Kings, proceeding from Arabia or Phœnicia, and gradually overrunning Egypt, then a seat of civilization. In the book of Exodus there is an account of the emigration of the children of Israel, given with great fullness of detail. One of the earliest of the long series of incursions of the uncivilized tribes of Asia was the great invasion of Cimmerians and Scythians (650 B. C.), which even threatened Egypt, but was turned back by Cyaxares, the founder of the kingdom of the Medes.

The Greeks, boasting their own origin from the sacred soil of Hellas, were pre-eminent among the ancients for encouraging systematic emigration. They planted their colonies far and wide along the Central Sea, and founded great cities not only throughout the Grecian Archipelago, but in Sicily, Italy, and Asia Minor, and even on Gallic shores, on the Iberian Peninsula, and on the African coast. The Romans, accepting mythical traditions as eagerly as the Greeks, found their own origin in an emigration from ruined Troy. But the policy of Rome, unlike that of Greece, fostered no rival colonies, and the emigrations which marked the rise of her power were principally the flight or transportation into slavery of the inhabitants of cities and provinces that yielded to her sway. The forced emigration of the slaves and captives of conquests reaches vast proportions in ancient annals. It was, however, after the empire of Rome had reached its culmination that the great movement of barbarian nations began, which is without parallel in the history of emigrations. A brief sketch of this movement, which continued through several centuries, can merely give prominent dates and names. The multitudes of those barbarian hosts can not be estimated; they have furnished the poet with his most appropriate comparison for the countless legions which issued from the nether abyss at Satan's command.

The southward emigration of the Goths from Gothland, or Northern Sweden, began A. D. 200; their first pressure in the empire was felt on the N. of the Euxine, and they soon crossed the Danube. By the middle of the century they had overwhelmed Greece. Meanwhile the Franks and Alemanni moved down in vast hordes from Western Europe, the former crossing the Rhine and the latter pouring through the Rhætian Alps. These incursions were checked by the victories of Claudian, Aurelian, and Probus (270–282), but the Goths established themselves during the following century on the borders of the Euxine, and spread through Thrace toward Italy. Between 376 and 410 was the climax of the movement of Northern races. The Huns, a nation of Tartar origin, coming down from the Ural Mountains and the table-lands of Siberia under Balamir, established an empire at the expense of the Goths, whom they drove out of the countries N. of the Danube; the latter, soon afterward marshaled under Alaric, after ravaging Greece, descended upon Rome, effecting its capture A. D. 410. During the same period the Vandals from between the Elbe and the Vistula, with the Sueves and Burgundians of kindred origin, and the Alans from the Caucasus, swept through Italy, and, thence withdrawing, through Southern France into Spain; the Burgundians alone stopping in the valleys of the Vosges, the rest, pressed by the Goths who followed them, finally reaching Andalusia. In 429 Moorish tribes from the base of Mt. Atlas were ravaging Northern Africa; in 439 the Vandals and Alans from Spain, under Genseric, following in the path of the Moors, extended the kingdom of the Vandals over the southern shore of the Mediterranean, and then crossing into Italy, captured and sacked Rome in 455. During the rise of the Vandal kingdom the Huns under Attila (435–450) swept down on the western provinces, and made an irruption into Gaul, but being defeated at Châlons in 451 they afterward withdrew to the E. of the Carpathian range. After Attila's death (453) the bulk of the remaining Huns retired to the shores of the Volga. During the same period the Saxons from between the Baltic and the Elbe, with the Angles to the N. of them, and the Jutes of Jutland, became dissatisfied with their homes, and in 449 descended on the coasts of Great Britain, establishing themselves on the island.

Before the year 470 the Slavi had overrun what are now Prussia, Poland, and Russia; about the middle of the sixth century this Slavic territory—and in fact the whole region from Franconia to the Caucasus, from Moscow to the Danube—was taken possession of by the Avars, a Tartar tribe. They unsuccessfully besieged Constantinople. Thenceforward, and indeed until the thirteenth century, the Byzantine empire was a bulwark against the Asiatic races, and prevented their penetrating Europe except by paths N. of the Euxine or S. of the Mediterranean. Starting from Arabian deserts in 632, the tide of Saracenic invasion rolled over the Levant and Northern Africa, entering Spain in 711, and was checked on the Loire by Charles Martel in 732. The Saracens spread from the Indus to the Atlantic, from the Pyrenees to the African desert, from the Caspian to the Red Sea. They invaded Sicily in 826, and held that island 265 years. The date of their conquest of India is 1004. Within the century when Europe was saved from the sword of the Saracen by the valor of Charles Martel, the victories of Charlemagne and his lieutenants (791–798) dislodged the Avars, and they withdrew to the eastward The Bulgarians, partly of Tartar extraction, entered on a portion of the deserted territory. The Magyars, a Finnish tribe from the Ural, about the year 855 united with the vanquished Avars, and spread in camps of 1,000,000 men over the Dacian plain. A century later Otho defeated their descendants, and they afterward settled on the Danube.

The Danish vikings in 852 effected a permanent settlement in Russia, but not till 980 did they become affiliated with the native Russians and Sarmatians. The incursions of Danes on the British coasts began early in the ninth century; in 1016 Canute's kingdom included Denmark, Norway, and England. The Danish and Norwegian vikings that were afterward called Normans ravaged the French coasts during this period, and settled in great numbers in Normandy in 912; they effected the conquest of England in 1066, and by 1072 had overrun Sicily and Southern Italy.

From the ninth to the eleventh century the Tartars ravaged China. In 1050 the Uzzi and Cumani, of Tartar extraction, overran all Southern Russia; they kept possession for 170 years. From 1216 to 1250 the Mongols under Genghis Khan, starting from the frontiers of China, created an empire, at a cost of 14,000,000 men slain by the sword, that extended from the Pacific to the Adriatic and the Baltic, overrunning all Southern Asia and Eastern Europe. The Mongols were probably allied to the Huns. After their victory on the Kalka in 1224, they held Russia subject for two and a half centuries. In the latter half of the thirteenth century, after the withdrawal of the Mongols from Hungary, its king invited immigration, and obtained many Italian, Flemish, and Saxon settlers. The empire of Tamerlane (1363–1405) again spread the Mongolian power over all Southern Asia; the conquest of Hindustan was effected in 1399, and Delhi afterward became the capital of the Great Mogul.

The crusades (1095, 1147, 1189, 1202, 1217, 1227, 1248, 1270), though involving great emigrations, created no permanent states.

The Ottomans had partially established themselves in Europe in 1356; by 1460 they had overrun Turkey. In 1550 the Turkish power was at its zenith, reaching from the Tigris to the Carpathian chain, from the snows of the Caucasus to the deserts of Abyssinia. The expulsion of the Mohammedans from Western Europe was an affair of centuries. They were driven out of Sicily in 1091; Valencia, 1238; Portugal, 1252; Granada, 1492.

From 1552 to 1577 the Russians pushed their conquests over the Mongolian races through two continents, and, crossing the Pacific to a third, effected settlements in North America, which in 1794 were estimated as containing 50,000 souls. The measures which culminated in the Revocation of the Edict of Nantes (1685) caused the Huguenot emigration from France, which numbered from 250,000 to 300,000 souls; Sismondi assigns even a higher figure. In 1739 India was subjected to a terrible invasion by the Persians; in 1765 the British conquest followed, and after it came a steady flow of Englishmen. The French emigration consequent on the revolution of 1790 consisted of noble families, and was exceptional in this characteristic. The czars, beginning with Peter the Great, have made notable and successful efforts in inducing foreigners to form colonies within their domain; and the last important movement of emigration within Europe was after Napoleon's wars, when Russia, by liberal offers, obtained 250,000 settlers, principally from her Western neighbors. In the Franco-German war (1870) 102,000 Germans were expelled from France, and after the war there was a large movement of the French population from Alsace and Lorraine, and subsequently an emigration thither from Germany.

There are evidences of extensive movements among the native populations of America before the advent of Columbus. The Esquimaux—or, as they call themselves, the Inuit—inhabiting the northern and northwestern coasts of America, are of a race found at the N. in the eastern hemisphere. The North American tribes of the interior were nomadic, but have left few definite records of their wanderings; the mound-builders spread all over the valley of the Mississippi and its tributaries, but did not reach the Atlantic coast, and the dates of their progress and extinction are alike unknown. The Shawanese within historic times moved down from the Northern Alleghanies along their western slope, and penetrated nearly to the Gulf of Mexico. There are records of many of the great movements of the races in the southern portion of North America. Torquemada, among earlier, and Clavigero, among later historians, have shown that the Toltecs, who during 104 years were advancing into Mexico from a region to the N. W. of it, founded the kingdom of Toltecan in the latter part of the sixth century. A famine nearly destroyed this nation in 1052; it was replaced in the next century by the less-civilized Chichimecas, and in the century following by other races from the N. and N. W., including the Aztecs or Mexicans from California. During the supremacy of the Toltecs in Mexico their fifth king invaded Guatemala, and there established a dynasty of Toltec sovereigns, of whom the eighteenth was reigning when the Spaniards arrived. In South America the Toupis emigrated from the northern borders of the Amazon, spread to the Caribbean Sea and most of its islands, and advanced southerly along the Atlantic coast to S. lat. 32°, penetrating inland to the headwaters of the Rio de la Plata; through all this vast region one native language was spoken. The origin of the race that entered Peru and built the monuments around Lake Titicaca is unknown.

With the progress of civilization the large movements of population *en masse* have been lessened, but the aggregate movement of individuals greatly increased. Large numbers of Europeans, in particular, have moved to other parts of the world, either in organized bodies to found states of their own—colonization—or to become citizens of states already established—immigration. Of the aggregate amount of such colonization or immigration it is hard to obtain full statistics. For the U. S. the facts are more accessible, and will be presented, together with the discussion of the social problems to which they give rise, under the heading IMMIGRATION (*q. v.*). See also COLONY and LIBERIA.

Revised by A. T. HADLEY.

Émigrés [Fr., emigrants]: in a special sense, those who fled from France during the Revolution. The movement began a few days after the storming of the Bastile, July 14, 1789, when the Prince of Condé and many of the nobles, alarmed at the course events were taking, emigrated to the Netherlands and Germany; it was renewed on a larger scale in October of that year, after the violence of the mob had caused the removal of the royal family from Versailles to Paris and made them virtual prisoners at the Tuileries; and when the constitution of 1791 was adopted, with its subversion of the ecclesiastical system and destruction of the privileges of the nobility, the number of fugitives greatly increased. The effect of this course upon the Revolution was very important. It deprived France of a conservative element at a time when such an element was most needed; it exposed the king's party at home to the suspicion of plotting with their absent friends; and, above all, by the intrigues of the *émigrés* with the powers hostile to the Revolution for the restoration of the old *régime* the mob was driven to its worst excesses. Their headquarters were at Coblentz, where, through their efforts, an army of 80,000 men was collected under the Duke of Brunswick. It was with the design of joining the forces of the *émigrés* that the king made his foolish and disastrous attempt at flight on the night of June 20, 1791. Under the Prince of Condé they followed the Prussian army into Champagne, with the result of bringing upon them the charge of high treason by the French Government, which passed against them and their sympathizers a series of most stringent laws, confiscating their lands, proclaiming the death penalty upon all who should communicate with or aid them, and placing 30,000 names on the list of perpetual exiles. After the failure to land at Quiberon in 1795, they gave up the hope of entering France by force, and many sought permission from the Directory to return. Under the general amnesty granted by the First Consul they returned in great numbers; but, though treated with honor, they could not by the terms of the charter of 1814 regain either their estates or their privileges. Yet during the reactionary reigns of Louis XVIII. and Charles X. the Ultras persistently agitated for their reinstatement and indemnification, and Villèle's ministry in 1825 brought about the granting of an annual compensation of 30,000,000 fr. for the loss of their estates; but the July revolution caused the withdrawal of the grant. F. M. COLBY.

Emil'ia [Lat. *Æmilia*, called after the celebrated Via Æmilia of the Romans, a continuation of the Via Flaminia forming the great highway through Northern Italy]: the ancient name of that part of Northern Italy which contains the former duchies of Parma and Modena and the papal delegations of the Romagna. The name was revived in 1859, and applied to a province of modern Italy lying S. of the Po, N. of the Appenines, E. of Piedmont, and comprising the eight compartments of Bologna, Ferrara, Forli, Modena, Parma, Piacenza, Ravenna, and Reggio Emilia. Area, 7,921 sq. miles. Pop (1890) 2,253,104.

Eminence: town (founded in 1849); Henry co., Ky. (for location of county, see map of Kentucky, ref. 2–G); on L. and N. Railroad; 40 miles E. by N. of Louisville. It has 4 churches, 2 colleges, a large flouring-mill, a harness-factory, a tobacco-factory, and a large distillery. The principal business is farming and stock-raising. The location is healthful, surrounded by a beautiful blue-grass region. There is a valuble mineral spring in the vicinity. Pop. (1880) 1,043; (1890) 1,002; (1900) 1,018.

EDITOR OF "CONSTITUTIONALIST."

Eminent Domain: the inherent sovereign power retained by the people or government over the estates or private property of individuals to resume or appropriate the same for public uses, and for public uses only. The difference between the power of taxation and the right of eminent domain should be carefully noted. Taxation proceeds upon the notion of contribution; it falls upon a class of persons, and is apportioned among them by rule. In the exercise of the right of eminent domain the state takes from an individual his property without reference to a burden imposed upon any other person. The right can be exercised in the U. S. either by a State or by the Federal Government. The power to decide whether the property should be taken for any public use rests with the Legislature, and its discretion is not reviewable by the courts, though it is conceived that the judicial power has the right to determine whether the use itself is public rather than private. Were this not so, the Legislature might, under pretense of taking property for public uses, transfer one man's property to another.

It is not necessary, however, that the exercise of the power should benefit the entire public. It is enough if it promotes the industrial capacity or resources of a considerable number of inhabitants, or in any manner indirectly contributes to the general welfare. It is not necessary that the State should act directly. The power may be delegated to a municipal body or to a private corporation. A State may delegate it to the U. S. The mode of excising it is regulated by constitutional provisions and by statutes. In some cases only an easement in land is acquired; at other times the entire fee is appropriated. The constitutional prohibition (U. S. Constitution, Amendments, Art. V.) against taking private property for public use without just compensation is a limitation on the power of the Federal Government, and not on that of the States. There are similar provisions in the State constitutions, binding the State legislatures. The compensation includes not only the property actually taken, but consequential damages to adjoining property. This has been carried so far in England that the House of Lords has held that a riparian owner on the banks of a navigable stream (the Thames) is entitled to compensation for the act of cutting off his approach to the river. The ground taken was that the right of access to a tide-water stream is a legal right, which would justify an action by the owner against one who interfered with it, unless Parliament had sanctioned the interference. (*Case of the Duke of Buccleuch*, *Law Reports*, 5, *House of Lords Cases*, 478, A. D. 1872.) Still, if *no* property is taken, a claim can not be made for consequential damages. The same right to compensation as is secured in the U. S. by constitutional provisions is recognized generally among civilized nations, and may be considered as a general rule in jurisprudence.

T. W. DWIGHT.

Emin' Pasha': assumed name of Eduard Schnitzer, an African explorer; b. in Oppeln, Prussian Silesia, in 1840. He was educated in the gymnasium at Neisse and the universities of Breslau and Berlin; graduated in 1864 as M. D.; went to Turkey in the same year and obtained a position on the staff of Hakki Pasha, whom he accompanied on a series of official journeys through Armenia, Syria, and Arabia. Hakki died in 1873, and Emin remained in Constantinople until 1875, when he returned to Germany. In 1876 he entered the service of the Khedive of Egypt as Dr. Emin Effendi, adopting the name Emin to avoid the Mohammedan prejudice against Europeans. He followed Gen. Gordon to the Sudan and in 1878 was appointed by him governor of the Equatorial province with the title of bey, and the Khedive made him pasha in 1887. In the catastrophes that followed the Mahdist rebellion he was left isolated, but still in control of his province. Here he remained until 1889, spending the time from 1881–85 at Lado, on the Bahr-el-Jebel, in lat. 5° N., and 1885–88 at Wadelai, 150 miles farther up the river. Meantime the fate of this oasis of civilization in the center of Africa attracted the attention of the civilized world, and Stanley's expedition for his relief was organized. Stanley met Emin on the Albert Nyanza on Apr. 29, 1888. After some delay and many vicissitudes in Emin's province they both made their way to Zanzibar, where, however, Emin met with an accident which prevented his return to Europe. On his recovery he entered the German service, and started from Bagamoyo, Apr. 26, 1890, at the head of an expedition 1,000 strong, to govern German territory between Tanganyika and Victoria. After establishing Bukoba on the west coast of Lake Victoria, he surveyed Lake Albert Edward, and vainly endeavored to penetrate the regions to the N. W. of Lake Albert. An outbreak of smallpox having compelled him to send most of his followers to Bukoba, he set out, on Mar. 9, 1892, without authority from his Government, for the Congo in the company of a band of Arabs, but was murdered by their leader, Oct. 23, 1892, when within a few days' march of the river. Emin's work as a naturalist and linguist placed him in the front rank of African explorers. His last expedition is described in *Mit Emin Pascha ins Herz von Afrika* (1894), by his companion, Dr. Franz Stuhlmann.

M. W. HARRINGTON.

Em'maus [Heb. *Hhammath*, hot spring]: a village in Palestine; about 7½ miles from Jerusalem; associated with one of the appearances of Christ on the day of his resurrection (Luke xxiv. 13). It was destroyed by an earthquake in 131 A. D., and when rebuilt in the third century was called Nicopolis. It is now only a small village, the modern Amwas.

Emmensite: See EXPLOSIVES (*The Picrates*).

Emmenthal Cheeses: See CHEESE.

Emmerich, em'mer-ich (anc. *Embrica*): town of Prussia; on the right bank of the Rhine; about 50 miles N. N. W. of Düsseldorf and 20 miles S. E. of Arnheim, with both of which it is connected by a railway (see map of German Empire, ref. 4–C). It has a custom-house, gymnasium, and several churches, also manufactures of iron, glass, woolen cloth, linens, hosiery, etc., and an active trade in wine. Pop. (1890) 9,622.

Emmet, ROBERT: patriot and orator; b. in Cork, Ireland, in 1778; son of a physician, and for a time a student in Trinity College, Dublin. He was a leader of the United Irishmen, who desired to liberate their country from British domination, and visited France in 1802 in behalf of the cause. Having secretly collected arms and powder in Dublin and formed a conspiracy, he and his friends revolted in July, 1803. The insurgents killed the chief justice, Lord Kilwarden, but were soon dispersed by a party of soldiers. Emmet fled to the Wicklow Mountains, but having returned to visit the daughter of John Philpot Curran, the orator, was arrested and tried for treason. He pleaded his own cause in a long and very eloquent speech, which has been preserved, but he was convicted and executed Sept. 20, 1803. His fate and his affection for Miss Curran are the subjects of two of Moore's *Irish Melodies*. See Madden, *Lives of the United Irishmen* (3d series, vol. iii. 1846).

Emmet, THOMAS ADDIS, LL. D.: lawyer; a brother of Robert Emmet; b. in Cork in 1764. He graduated at Trinity College, Dublin, and was admitted to the Dublin bar in 1791, soon attaining distinction, but was a leader of the United Irishmen, and as such was arrested in 1798, and confined in prison for nearly three years. His sentence was commuted into exile, and he emigrated in 1804 to New York city, where he practiced law with distinction. He was elected attorney-general of the State of New York in 1812. He was an eloquent advocate, and had great qualities as an orator. Some sketches of Irish history by Mr. Emmet are included in McNevin's *Pieces of Irish History* (New York, 1807). D. in New York, Nov. 14, 1827.

Emmetsburg: city (founded in 1868); capital of Palo Alto co., Ia. (for location, see map of Iowa, ref. 2–E); on the Des Moines river, and the Chi., Milwaukee and St. Paul and Burlington, Ced. Rap. and N. R. Rs.; 55 miles N. N. W. of Fort Dodge and 25 miles W. of Algona. It has 3 churches (5 church societies), 3 public-school buildings, a large packing-house, flouring-mill, water-works, etc., and is the center of a dairying and stock-raising district. Pop. (1890) 1,584; (1900) 2,361. EDITOR OF "REPORTER."

Emmitsburg: village; on railway; Frederick co., Md. (for location of county, see map of Maryland, ref. 2–D); 8 miles N. of Mechanicstown, 1 mile from Mason and Dixon's line, and 10 miles from Gettysburg, Pa. It was laid out by William Emmitt, its founder, about the year 1773. The original settlers were Scotch and Irish. Mt. St. Mary's College was established near it in 1809 by Rev. John Dubois, Bishop of New York; it is a Roman Catholic institution, one of the largest in the U. S. St. Joseph's Academy, about half a mile from town, was established in 1810, by Mrs. Eliza Ann Seton, of New York. It is the mother-house of the Sisters of Charity in the U. S., numbers 2,000 members, and has one of the largest educational buildings in Maryland. Pop. (1880) 847; (1890) 844; (1900) 849.

Emmius, UBBO: historian; b. at Greith, in the province of Ost-Friesland, Holland, Dec. 5, 1547. He studied at Emden, Bremen, Norden, and Rostock, but returned to his native town in 1570. In 1574 he set out on a new trip through the Rhine countries down to Geneva, where he was converted by Beza to Protestantism. Having returned through France, he was in 1579 made rector of the school of Norden, but refused in 1587 to subscribe the Confession of Augsburg, and was consequently expelled by the Lutherans. In 1594 he was made director of the college of Liers, and in a few years he made it one of the most celebrated educational institutions in Holland. Among his works are *Opus Chronologicum novum* (Groningen, 1619), an attempt at a chronological arrangement of history from creation; *Vetus Græcia illustrata* (Leyden, 1626), several times reprinted; *De origine et antiquitate Frisiorum* (Groningen, 1603); *Rerum Frisicarum Historia* (Franeker, 1596), a work which encountered considerable opposition on account of its invectives against the Roman Catholic Church. D. at Groningen, Dec. 9, 1626.

Emmons, NATHANAEL, D. D.: theologian; b. at East Haddam, Conn., Apr. 20, 1745; graduated at Yale College in 1767. He was ordained pastor of the Congregational church in Franklin, Mass., in 1773, and was its pastor until his death, and its sole pastor for fifty-four years. In addition, he trained fifty-seven young men for the ministry, many of whom became eminent. He was also a prominent advocate of foreign missions and of the anti-slavery cause. His theological views were nearly those of his friend Dr. Samuel Hopkins. The distinctive tenets of his system are: "Holiness and sin consist in free, voluntary exercises. Men act freely under the divine agency. The least transgression of the divine law deserves eternal punishment. Right and wrong are founded in the nature of things. God exercises mere grace in pardoning or justifying penitent believers through the atonement of Christ, and mere goodness in rewarding them for their good works. Notwithstanding the total depravity of sinners, God has a right to require them to turn from sin to holiness." His sermons were distinguished by logical thought and by dignity and power of style. D. in Franklin, Mass., Sept. 23, 1840. His works (sermons, essays, etc.), published at different times during his life, were after his death published (Boston, 1842) in seven and afterward (Andover, 1861) in six volumes, with memoirs of his life by J. Ide, D. D., in the first edition, and a full biography by Prof. E. A. Park in the second.

Emory, JOHN, D. D.: bishop of the Methodist Episcopal Church; b. in Queen Anne co., Md., Apr. 11, 1789; graduated at Washington College, Md., 1804; was admitted to the bar, 1808, but became a Methodist preacher in 1810; preached for many years through the Middle States; and was sent as delegate of his denomination, in 1820, to the British Wesleyan conference. He was elected in 1824 assistant book agent at New York, agent in 1828, and bishop in 1832. In 1817 he had a pamphlet controversy with Bishop White, of Philadelphia. He was author of *The Divinity of Christ Vindicated*, *Defense of Our Fathers*, and other publications, which show much logical ability and a pure and vigorous style. D. at Reisterstown, Md., Dec. 16, 1835. See his *Life* by his son Robert (New York, 1840).

Emory, WILLIAM HEMSLEY: U. S. army officer; cousin of John Emory; b. in Queen Anne co., Md., Sept. 9, 1811; graduated at West Point in 1831, and was appointed lieutenant of artillery; served chiefly at seaports in the Eastern States, and in the Creek nation 1831–38; appointed first lieutenant topographical engineers 1838; on staff of Gen. Kearny in California and during the Mexican war; astronomer of boundary between California and Mexico 1848–53; and commissioner and astronomer 1854–57 (brevet lieutenant-colonel); resigned in 1861, and was reappointed; appointed brigadier-general of volunteers in 1862; commanded a division under Gen. Banks in Louisiana 1863, and a corps in 1864; in 1864 fought with distinction at Pleasant Hill, Opequan Creek, and at Cedar Creek (brevet major-general); in command of department of West Virginia 1865–66, of Washington 1869–71, and of the Gulf 1871–75; retired as brigadier-general 1876. D. Dec. 1, 1887.

Emory College: an institution of learning located in Oxford, Ga.; 41 miles E. of Atlanta and a mile from the Georgia Railway. The college was chartered in 1837, and was opened in 1838 under the presidency of the Rev. Ignatius A. Few, D. D., LL. D. The college curriculum is full in all the departments taught in first-class institutions in the U. S. There are 14 members in the faculty, and the enrollment for 1899–1900 numbered 289 students. The college is well supplied with buildings for recitation and other uses. It has an endowment of $225,000, much of it being the gift of Mr. George I. Seney, president of the Metropolitan Bank, New York. Its president is C. E. Dowman, A. M., D. D. The institution is under the patronage of the Methodist Episcopal Church South, but it has gathered students from all Protestant denominations.

Emotional Expression: See the Appendix.

Emotions: See IDEAL FEELINGS.

Emped'ocles (in Gr. Ἐμπεδοκλῆς): Greek philosopher; b. at Agrigentum in Sicily; lived about 450 B. C. He acquired great fame and influence by his talents and varied attainments in science. It is said that his fellow-citizens offered him the crown, but he declined it, and used his influence to found a republic in his native state. He was regarded as a public benefactor, a great poet, and a great prophet. He maintained the theory that the world is developed from or compounded of four primary elements, fire, air, earth, and water, and that there are two forces, love and hate (attraction and repulsion). He wrote, besides other works, a poem on *Nature*, of which numerous and important fragments are extant which show a truly poetical vein. It appears that he accepted the doctrine that the souls of some men, at least, are destined to migrate through animal or vegetable bodies in order to purify them. The story that he threw himself into the crater of Mt. Etna to immortalize his name seems to be mere fable. He was admired by Aristotle and Lucretius, the latter of whom eulogizes him in his poem *De Rerum Naturâ*. The fragments of Empedocles have been edited by Stein (1852) and others. See Ritter, *History of Philosophy*; Zeller, *Philosophie der Griechen* (vol. i.); Zeller, *Pre-Socratic Philosophy* (vol. ii.); Mullach, *Fragmenta Philosophiæ Græcæ*; Gladisch, *Empedocles und die Ägypter* (1858.) Revised by B. L. GILDERSLEEVE.

Emperor [from Lat. *impera'tor*, commander, deriv. of *impera're*, command]: a sovereign who rules over an empire. The title *imperator* was conferred by the ancient Romans on their consuls in their military capacity, after this authority had been confirmed to them by the *comitia curiata.* The signification of imperator depended on that of *imperium*, which was the name given to the supreme power of the senate and people of Rome over the city and subject provinces. An officer clothed with authority by law exercised this imperium within the limits and time of his command. After any great victory the soldiers were accustomed to salute their commander as imperator as a compliment, though, as exercising the imperium attached to his command, he was already such in fact. He might be a consul or a proconsul, and the imperium was as necessary for a governor of a province as for a general who merely commanded an army. Under the republic there might be many *imperatores* at one time. On the subversion of the republic the title was conferred on Augustus for life. The authority of the Roman emperors was acquired by the combination of the chief offices of the former republic in a single person, besides which some extraordinary powers were granted or usurped. Thus Octavius held the title of imperator and the office of consul by successive elections. He was made tribune, which gave inviolability to his person, and pontifex maximus and censor, which gave him control of religion and morals. He was also invested with perpetual proconsular authority, which gave him supreme control in all the provinces, and declared chief (*princeps*) of the senate, and Augustus. The last designation was assumed by his successors. The title imperator was assumed by the emperors on the occasion of victories by themselves or their armies. Aurelius is represented on a coin as imperator for the eighth time. With the early Roman emperors the term imperator did not denote the sovereign power. It is not easy to determine at what time the word came to be used in the modern sense of emperor as the proper name for the sovereign of the Roman state. The term *princeps* was used as a convertible term with it. The Roman emperors appointed their own successors, who received the title of cæsar during the life of the emperor who appointed them. After the court was removed to Constantinople the old titles and forms of the republic gradually vanished, and the emperors assumed the style of Oriental princes. The title of emperor of the Romans was conferred on Charlemagne by Pope Leo III. in 800 A. D., and was borne by his successors until the dissolution of the Holy Roman Empire in 1806.

After the Greek empire had been divided into two parts in 1204, the rulers of both parts continued to bear the title of emperor, the Latin emperor residing at Constantinople, and the Greek emperor at Nicæa. In 1263 the two parts were reunited, and in 1328 the Greek empire was again divided into the empire of Constantinople and that of Trebizond. After the Turks had conquered these empires the sultans assumed the title of emperor, which was recognized by the European powers in 1606. Czar Peter I. of Russia assumed the imperial title in 1721. After the dissolution of the Holy Roman Empire in 1806 the rulers of Austria assumed the title of Emperor of Austria. On Jan. 18, 1871, King William I. of Prussia assumed the title of Emperor of Germany at the request of all the German princes. In France Napoleon I. assumed the imperial style in 1804, and Napoleon III. in 1852. Several attempts have been made to establish empires in America, but all have failed. In Mexico Iturbide assumed the title of emperor in 1822, and Maximilian of Austria in 1864. In Haiti the Negroes Christophe, in 1811, and Soulouque, in 1849, reigned for a short time as emperors, but were soon deposed. The rulers of Morocco, China, and Japan are also sometimes called emperors. The modern idea of an empire in general seems to be a union of states, each with a local government, under the protection or political preponderance of one powerful state. The personal sovereign of such a state may by conquest or election become the emperor, sustaining a special governing relation to his own hereditary dominions, and a general control as emperor over the confederated, yet subordinate, states of the empire. But there is a tendency toward a looser use of the term as a mere title of the head of a kingdom. Revised by C. K. ADAMS.

Emperor Goose: See GOOSE.

Emperor Moth: the largest British lepidopterous insect (*Saturnia pavonia minor*); allied to the silkworm moth; belonging to the *Bombycidæ*. Its wings when expanded measure 3½ inches, each wing having a large transparent spot. The peacock moth (*Saturnia pavonia major*) is 5 inches across the wings, and is the largest species in Europe. Silk is had from cocoons of certain species of this genus.

Emphyse'ma [Gr. ἐμφύσημα, a puffing up; ἐν, in + φυσᾶειν, blow, distend]: in pathology, an inflation produced by air or gas in the cellular tissue. Emphysema of the lungs is owing to dilatation of the air-vesicles.

Emphyteu'sis [Gr. ἐμφύτευσις, an implanting; ἐν, in + φυτεύειν, plant]: in Roman law, a species of perpetual lease of land for a fixed annual payment. This for a long time was confined to the public lands, but was eventually extended to private lands. The person who received the right of emphyteusis could treat the land almost exactly as if he were owner. He could lease it, pledge it, or sell it, and at his death it descended to his heirs. In case of a sale, however, he had to first offer it to the owner at the same price, and the latter could take it or demand a fee for his acceptance of the new occupant. It resembles, but is distinct from, the Scottish grant in feu-farm.

Revised by F. STURGES ALLEN.

Empire: See EMPEROR.

Empiric [from Gr. ἐμπειρικός, experienced (οἱ ἐμπειρικοί, a sect of physicians who held that practice (ἡ ἐμπειρική) was the basis of their art), deriv. of ἔμπειρος, skilled; ἐν, in + πεῖρα, trial]: one whose knowledge or skill is founded on experience or experiment. In the time of Celsus and Galen there was a medical sect called *Empirici*, supposed to have originated with Philinus of Cos and Serapion. These empirics were opposed to the *Dogmatic* sect or school, and considered that medical science should be based on experience rather than on theory. But they extended their idea of theory so far that they excluded anatomy from the medical study as a mere theoretical dream, and they narrowed their idea of experience so much that their whole art came to consist in prescribing certain remedies for certain ailments, without paying any regard to the natural requirements of the individual patient or the peculiar exigencies of the particular case. They became so notorious for ignorance that the term empiric is generally applied to quacks and practitioners who are ignorant of medical science. In its application to philosophy empiric denotes one who depends for truth entirely upon sensual experience, independent of those limitations of the mind's constitution which condition and supplement it. (See SENSATIONALISM.) Empiricism is a name applied by many of the German schools of philosophy to the system which may be called that of observation and induction, relying upon phenomena which are made evident in consciousness. They apply the term to the methods of Locke, Reid, and Stewart, without properly discriminating them from the materialists, to whom the term, in both ancient and modern times, has been legitimately applied.

Empiricus: See SEXTUS EMPIRICUS.

Employer's Liability: See MASTER AND SERVANT and NEGLIGENCE.

Empoli: town of Italy; province of Tuscany; on the river Arno; 16 miles W. of Florence (see map of Italy, ref. 4–D). It has an interesting church, founded in 1093, and adorned with paintings by Giotto; also manufactures of cotton fabrics, straw hats, etc. Pop. 7,500.

Emporia: city and railway center; capital of Lyon co., Kan. (for location, see map of Kansas, ref. 6–I); on the A., T. and S. F. and the M., K. and T. R. Rs.; 6 miles above the junction of the Neosho and Cottonwood rivers, in a fine agricultural and stock-raising region; has a State normal school, the College of Emporia (Presbyterian), endowed by the synod of Kansas, excellent graded schools, a business college, conservatory of music, a canning-factory, street railways, gas, and electric lights, excellent water-works, etc. Pop. (1880) 4,631; (1890) 7,551; (1900) 8,223. EDITOR OF "REPUBLICAN."

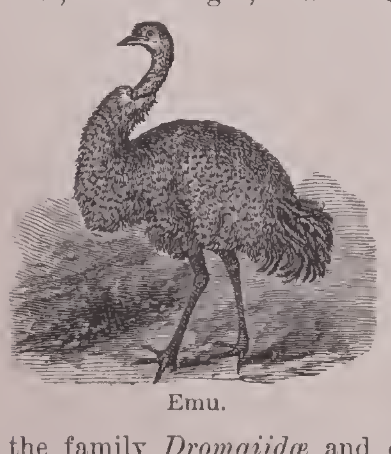
Emporium: borough and railway junction; capital of Cameron co., Pa. (for location of county, see map of Pennsylvania, ref. 3–D); 99 miles W. N. W. of Williamsport. It has iron-works and an important trade in lumber and coal. In the vicinity are valuable salt-wells. Pop. (1880) 1,156; (1890) 2,147; (1900) 2,463. EDITOR OF "CAMERON COUNTY PRESS."

Empson, Sir RICHARD: the extortionate minister of Henry VII. and associate of EDMUND DUDLEY (*q. v.*) in levying the taxes and collecting the fines imposed by the king; was Speaker of the House of Commons in 1491, and subsequently held other important offices. He was brought to trial soon after the accession of Henry VIII., and, in spite of his defense claiming the strict legality of all his acts, was convicted of constructive treason and executed with Dudley on Tower Hill, in Aug., 1510.

Ems, (anc. *Ami'sia* or *Ami'sius*): a river of Germany; rises in Prussian Westphalia, near Paderborn. Its general direction is northward. After a course of about 200 miles it enters the Dollart, an inlet of the North Sea, near the town of Emden. It is connected by a canal with the Lippe.

Ems (anc. *Amisia*), or **Bad-Ems**, baat'ems' (i. e. bath of Ems): a watering-place in Hesse Nassau, Germany; on the river Lahn; about 7 miles S. E. of Coblentz (see map of German Empire, ref. 5–D). It is surrounded by picturesque scenery, and is situated in a beautiful valley among wooded hills. Here are warm mineral saline springs, the temperature of which varies from 93° to 135° F. It has good hotels, and is frequented by many visitors, both native and foreign. In 1785 the Archbishops of Treves, Mayence, Cologne, and Salzburg formed an agreement here, called the Punctation of Ems, in which they demanded in twenty-three articles the change of several papal privileges in favor of the German archbishops. The real object, however, was the establishment of a national German Church. But in consequence of the opposition of their own bishops and the firmness of the pope, they were compelled to submit to the authority of the pope within a year. On July 13, 1870, the French ambassador, Count Benedetti, had at Ems the famous interview with King William of Prussia which precipitated the outbreak of the great war between France and Germany. Pop. (1890) 6,356.

Em'ser, HIERONYMUS: Roman Catholic theologian and adversary of Luther; b. at Ulm, Germany, Mar. 26, 1477. He studied at Tübingen and Basel; accompanied Cardinal Raymond, of Petrandi, on his tour of visitation through Germany; lectured afterward in the true humanist manner at Erfurt, where he had Luther among his hearers; and finally became private secretary to Duke Georg of Saxony and the incumbent of several rich benefices. His first literary efforts were some essays on the propriety of giving toasts when drinking, on the improvement of wine, beer, and vinegar, etc. Then followed a life of Bishop Benno, which is found in the *Acta Sanctorum*. His principal work, however, is his notes on Luther's translation of the Bible, which Luther approved in many cases. His own translation (1527) from the Vulgate is, however, dependent on Luther's. See edition of his writings by Enders (Halle, 1890). D. at Dresden, Nov. 8, 1527.



Emu.

Emu, or **Emeu**: a large Australian bird (*Dromaius novæ hollandiæ*), belonging to the family *Dromaiidæ* and order *Casuarii*, and allied to the ostrich and cassowary. It differs from the cassowary in being taller, having the bill horizontally depressed, and in being destitute of the bony crest and pendent wattles. When full-grown it is of a brown color, mottled with gray. It has only rudimentary wings, but is exceedingly fleet in running. The eggs are dark green, and about seven in number. Both the eggs and flesh are esteemed excellent for the table. Its plumage is long and almost hair-like. The plumes are readily dyed of various colors, and appear to some extent in commerce as a substitute for ostrich-feathers. The emu has become rare in the more settled parts of Australia, having been hunted for the sake of its oil, which the skin contains in large quantities. It feeds mostly on fruit, herbage, etc., and is easily domesticated.

Emu Wren: a passerine bird (*Stipiturus malachurus*) of Australia; a member of the thrush family (*Turdidæ*). The genus includes about a dozen Australian species. This

Emu wren.

bird haunts marshy districts, never alighting on high trees, and seldom taking to flight, but running rapidly about the grass with its long tail-feathers erect. It takes its name from these feathers, which are six in number and from the looseness of their barbs suggest those of an emu. F. A. L.

Emulsin (*Synaptase*): an albuminous substance found in almonds. It acts as a ferment upon the glucoside amygdalin of bitter almonds, transforming it into bitter almond oil (hydride of benzoyl), hydrocyanic (prussic) acid, and glucose (grape-sugar).

Emydidæ [deriv. of *Emys*, the typical genus; from Lat. *emys*, Gr. ἐμύς, fresh-water tortoise]: a family of turtles containing the majority of the smaller fresh-water and land turtles; in all, some sixty species. The upper and under shells (carapace and plastron) are well developed; the feet are usually webbed and adapted for both walking and swimming; and, with few exceptions, there are five claws on the fore feet, four on the hind. Some species of the family, like the box-turtle (*Cistudo*, or *Terrapene carolina*), are exclusively terrestrial, and have the high, arched back, but not the club feet of the true tortoises. A few dwell in brackish water, but the majority are found in the fresh waters of the north temperate and tropical regions. These turtles are rather omnivorous, feeding on various plants, fishes, and worms. The family numbers among its members some which are quite extensively used for food, the most noted being the diamond-back terrapin (*Malacoclemmys palustris*) of the Southern U. S. By some authorities the *Emydidæ* are considered as belonging to the *Testudinidæ*, while others consider the box-turtle as forming a distinct family, the *Cistudinidæ*. See TESTUDINATA.

F. A. LUCAS.

Enaliosau'rians [from Gr. ἐνάλιος, marine (ἐν, in + ἅλς, sea) + σαῦρος, lizard]: a group of extinct saurians having paddles for swimming instead of true feet, and having crocodilian teeth and biconcave vertebræ like those of fishes. Their remains first appear in the Carboniferous rocks, and disappear in the Cretaceous, being most numerous in the Jurassic strata. They appear to have been mostly or all marine. *Ichthyosaurus* is one of the most important of the genera.

Énambuc, or **Esnambuc**, PIERRE VANDROSQUE DIEL, d': founder of the French colonies in the West Indies; b. at Dieppe about 1570. He engaged in privateering cruises, and in 1625 commanded a Dieppe vessel in the West Indies; attacked by a Spanish fleet he took refuge in the island of St. Christopher on the same day that the crew of an English vessel landed there. The French and English agreed to divide the island between them and found permanent colonies. In this plan they were supported by their respective governments, and d'Énambuc formed in France a company for colonizing the West Indies. He took out 530 immigrants in 1626, and others in 1629, and, though the Spaniards drove him from St. Christopher in Dec., 1629, he returned, strengthened his colony and founded others in various islands. D. at St. Christopher, Dec., 1636.
HERBERT H. SMITH.

Enamel [pref. *in*, *en* + O. Fr. *esmal*, *esmail* > Mod. Fr. *émail* : Ital. *smalto*, a loan-word from Teutonic]: a soft and easily melted glass, which is used in many of the arts. It is sometimes opaque, as the white coating of a watch-face, or the lining of some cooking-vessels, and sometimes transparent, as the glaze on fine porcelain. Enamel is generally delivered either in small sticks or cakes to those who work in it. These are ground, and the fine powder is applied to the surface which is to receive it with the brush, and a medium of some kind, usually water. Exposure to heat fuses it, and it cools in a solid skin attached to the background. In the fine arts both the opaque and the transparent kinds are much used. Sometimes the enamel serves as a surface to paint upon in vitrifiable colors. For this purpose the enamel is spread upon a metal plate, usually copper, exactly as is done with watch-faces. The painting may be in monochrome or in vivid colors, and gold can be used very easily. The best known and most important variety of this painted enamel is that known as *Limoges enamel*, the best of which belongs to the middle of the sixteenth century, when there were produced splendid plaques, goblets, and tankards which now bring enormous prices. *Battersea enamel*, produced in England in the eighteenth century, is another variety. Much painted enamel in small pieces for insertion in jewelry was made in France between 1865 and 1885. Much is made in China, with light ground covered with flowers and patterns, and applied to decorative and even to useful vessels. In all these the enamel serves as a background to paint upon exactly as pottery or porcelain would. In other cases the enamel itself, colored in its own substance, forms the pattern. In *cloisonné enamel* a metal background has little strips of wire of a square section fastened to it, outlining the pattern; the enamel powder of different colors is put into these compartments, and the heat fuses them all into smoothness. The whole surface is generally, but not always, ground even and polished. This is the kind most commonly used by the Chinese and Japanese for vases, etc. In *champlevé enamel* a part of the metal surface of an object is engraved rather deeply in a sort of pattern, the hollow being filled with the enamel, which thus shows on a background of the metal. This has always been more common in Europe, and it is much used for jewelry. *Enamel en basse taille* is a variety of this, its peculiarity being that the enamel is transparent and shows a pattern in relief left at the bottom of the hollow in the metal. No decorative art allows of more brilliant color-effects than work in enamel.

The enamel applied to porcelain is of the nature of a thin glaze. Some of the painting applied to the piece is put on before the enamel, some upon the enamel, and the colors are distinguished in this way. See POTTERY and PORCELAIN.
RUSSELL STURGIS.

Enameled Leather: leather the surface of which is rendered glossy by successive coats of linseed oil, and finally of a varnish of copal and asphaltum. See LEATHER.

Enamel Painting: the art of applying painting to glass, pottery, or the metals, much glass-staining being simply enamel painting. The various colors (chiefly oxides of lead, platinum, gold, titanium, uranium, chromium, etc.) are mixed with some glass or "flux," ground, made into a paint with oil of spike or some other volatile oil, and then applied with a soft brush, the outline being usually first applied and then burnt in. Some faint idea of the needed skill may be formed from the fact that the painter has to work not with actual colors, but with substances which he knows will produce these colors after firing.

Encaustic Painting [*encaustic* is from Gr. ἡ ἐγκαυστική (sc. τέχνη, art), the encaustic art, deriv. of ἐγκαύειν, burn in]: a durable species or method of painting which was practiced by the ancient Greeks upon the inner and outer walls of buildings and upon sculptures in marble, and which was one of the commonest kinds of painting among the artists of the Roman empire. It was so called from the process of burning the picture when completed. The pictures were executed with wax colors (*ceræ*), and finished by the application of a hot iron. The effect of an encaustic picture was similar to that of an ordinary *tempera* or water-color painting, but with a somewhat more glossy surface. Encaustic painting has not been practiced with much success or to much extent by the moderns.

Encaustic Tiles: See TILES.

Enceinte, äañ'sañt' [Fr. < Lat. *in* + *cincta*, partic. of *cin'gere*, gird]: in fortification, the main inclosure or the (generally) continuous inclosing line of wall and parapet of a fort or fortress. It is the inner boundary of the main ditch, and, according to its trace or system, upon which its contour is broken, it distinguishes the character of the work as bastioned, polygonal, tenaillé, etc. See FORTIFICATION.

Enchasing: See CHASING.

Enchorial: See DEMOTIC WRITING.

Encina, or **Enzina**, JUAN, del: the "Father of the Spanish drama"; b. in Encina, near Salamanca, about the year 1469. After completing his studies at the University of Salamanca, he found employment as a court poet in the house of D. Fadrique de Toledo, first Duke of Alba. In 1496 he published a collection of his poetical works entitled *Cancionero*, containing, besides a treatise on the art of poetry, a number of lyric and dramatic poems. These latter are partly mysteries, partly pastoral pieces called by Encina *eglogas*. Being represented before a cultivated audience in the house of the Duke of Alba, independently of religious festivals, and drawing their characters from real life instead of from the liturgy, Encina's plays became the starting-point of the secular drama of Spain. Of another dramatical poem attributed to Encina, entitled *Farsa de Plácido é Vitoriano*, all that is known is that it was printed in Rome in 1514. In 1519 Encina made a pilgrimage to Palestine. He spent the last years of his life in his native country, and died at Salamanca in 1534. HENRY R. LANG.

Enciso, MARTIN FERNANDEZ, de: Spanish lawyer; b. about 1470. In 1500 he went to America with the expedition of Bastidas, and remained at Santo Domingo, where he became a prosperous lawyer. When, in 1509, Ojeda stopped at Santo Domingo on his way to colonize Tierra Firme, he induced Enciso to invest his fortune in the enterprise, making him lieutenant. Ojeda sailed in Nov., 1509, and Enciso followed six months later with another ship. He found only a handful of survivors of Ojeda's colony; with these and his own men he founded DARIEN (*q. v.*). Deposed soon after by Balboa, he went to Spain, but returned in 1514 as a legal officer in the company brought by Pedrarias; thereafter he was one of the most determined foes of Balboa. Enciso published in 1519 a *Suma de geografía*, which contains the first Spanish account of the New World, and is otherwise valuable. D. after 1528. HERBERT H. SMITH.

Encke, en'ke, JOHANN FRANZ: astronomer; b. in Hamburg, Germany, Sept. 23, 1791. One of his best-known works is his discussion of the transits of Venus of 1761 and 1769, leading to a distance of the sun equal to 95,000,000 miles. This result is now known to be more than 2,000,000 miles too great. In 1825 he was appointed director of the Royal Observatory at Berlin and secretary of the Academy of Sciences. He investigated the orbit and movements of the comet which Pons discovered in 1818, and which is now designated Encke's comet. In 1830 he began to edit the *Astronomische Jahrbücher*. D. at Spandau, Aug. 26, 1865.

Encke's Comet: a comet observed by Pons on Nov. 26, 1818. In 1819 Encke first demonstrated that the same comet had been seen as early as 1786, and several times subsequently. He also found that its period was about 1,200 days (3·303 years), its successive returns being accelerated and its period shortened by a minute interval of time. It has the shortest period and the least aphelion distance of all the known comets.

En'cratites [Gr. Ἐγκρατῖται, the self-controlling], also called Hydroparastatæ, from their substitution of water for wine in the Eucharist: an heretical sect dating from the second century, which inculcated and practiced total abstinence from flesh, wine, and marriage. Subsequently the name was applied to the ascetic Gnostics generally.

Encrinite [deriv. of *encrinus*; Gr. ἐν, in + κρίνον, lily]: the popular name for crinoids, radiated animals which form an order in the class *Echinodermata*. The encrinites comprise many genera and species, nearly all of which are fossil. They abound in the Paleozoic rocks, and are quite numerous in the Mesozoic formations. Encrinites are exceedingly rare, and for many years only one species (*Pentacrinus caput medusæ* of the West Indian seas) was known. Deep-sea dredging expeditions brought to light two or three more. *Comatula* in its early stage of existence so much resembles the encrinites that it was described as a crinoid (*Pentacrinus europæus*), but in *Comatula* the stem is temporary, in the crinoids permanent. The stem consists of disks like button-moulds in form, set in a pile together, and in the living animal has some flexibility. It is mostly round or pentagonal, and is often finely sculptured on the articulating surfaces. Each joint of the arms is furnished with two cirri or appendages, which the animal uses in capturing its prey. The number of joints in the *Pentacrinus briareus* is, according to Buckland, about 150,000. Immense numbers of these animals lived in the seas of the Paleozoic ages.

Revised by J. S. KINGSLEY.

Encumbrance: See INCUMBRANCE.

Encyclopæ'dia, or **Cyclopædia** [*encyclopædia* is from Gr. ἐγκυκλοπαιδεία, a questionable compound for ἐγκύκλιος παιδεία, regular (course of) education, the liberal curriculum]: a compilation usually, but not always, in alphabetic arrangement, which professes to impart information, more or less complete, upon the whole circle or range of human knowledge. The most noted of the earlier cyclopædic works were the work of Speusippus (the nephew of Plato, d. B. C. 339), not now extant; the great collections of Varro, of the Elder Pliny, of Stobæus, Suidas, Isidorus, and Capella, crude summaries of the then known arts and sciences; the *Speculum Majus*, in four parts, of Vincent de Beauvais (3 vols., 1264); and other similar compilations. The work of Alfarabi, of Bagdad (d. A. D. 950) is also worthy of mention. The Chinese in the course of their long history have compiled and issued many remarkable and usually very voluminous encyclopædias. Among them may be mentioned the *Tai-ping-yu-lan* in 1,000 books, compiled by order of the second emperor of the Sung dynasty, and completed in 983. In 1568 a new edition of 500 sets was printed from movable type, and a later one in 1812. In the reign of the second emperor of the Ming dynasty another great cyclopædia, called the *Yung-lŏ-ta-tien*, was compiled in 22,877 books (with 60 books of tables of contents). It comprised the whole round of Chinese learning—classical, historical, philosophical, and literary, embracing astronomy, geography, medicine, the occult sciences, Buddhism, Taoism, and the arts. Over 2,000 scholars were engaged in the work, which was finished in 1407, and ready for printing two years later. No complete copy is now in existence. In the period K'ang-hi, the second of the present dynasty, another great cyclopædia, the *T'u-shu-tseih-ch'ing*, in 10,000 books, forming 5,020 volumes, was prepared, and printed at Peking by imperial command, from movable copper type (in two sizes) in the following reign (1726). A copy of this immense and valuable work was secured in 1877 for the British Museum in London. Its subjects are arranged in six categories and thirty-two sections, under 6,109 headings. The indexes extend to twenty volumes more.

The earliest modern encyclopædia was that of J. H. Alsted (b. 1588, d. 1638), which appeared in 35 books in the year 1630. L. Moréri's *Grand Dictionnaire* appeared in 1673; Hofmann's *Lexicon Universale* (2 vols.) in 1677; T. Corneille's *Dictionnaire des Arts* (2 vols.) in 1694; and P. Bayle's *Dictionnaire Historique et Critique* (4 vols.) in 1697. In the eighteenth century the principal works were J. Harris's *Lexicon Technicum* (2 vols. folio, London, 1710); Ephraim Chambers's *Cyclopædia* (2 vols. folio, 1728); Zedler's *Universal-Lexikon* (64 vols., Leipzig, 1732–50); the French *Encyclopédie* of the "Encyclopédists" Diderot, d'Alembert, Voltaire, Rousseau, Grimm, and Helvétius (28 vols., 1751–72; 7 vols., 1776–80); the *Encyclopædia Britannica* (3 vols., 1771; 2d ed. in 10 vols., 1776–83; 3d ed. in 18 vols., 1797); the *Deutsche Encyklopädie* of Köster and Roos (1778–1804); and the *Encyclopédie Méthodique par Ordre des Matières* (201 vols., 1781–1832). In the nineteenth century the first European work was Dr. A. Ree's *Cyclopædia* (45 vols., 1802–19). A work called the *British Encyclopædia*, edited by Thomas Dobson, was published in Philadelphia, 1798–1804; Dr. Brewster's *Edinburgh Encyclopædia* (18 vols., 1810–30) followed. The *Conversations-Lexikon* of F. Brockhaus (Leipzig, 1813), of which thirteen editions have appeared, was the basis of many other cyclopædias. The *Encyclopædia Metropolitana* (30 vols. 4to, 1818–45) was a series of scientific treatises, as was also *Lardner's Cyclopædia*. The *Encyclopædia Americana* (1829–33, 13 vols., and supp. vol., 1848), edited by Prof. Lieber, was based on the *Conversations-Lexikon*. The *Penny Cyclopædia* (28 vols., 1833–43), subsequently rearranged in four divisions and twenty-seven volumes as the *English Cyclopædia*; the *Encyclopædia Britannica* (4th to 9th editions, of which the ninth appeared in 24 vols. and index vol., 1875–89); the *London Encyclopædia* (22 vols., 1829); and Messrs. W. & R. Chambers's *Encyclopædia* (10 vols., 1859–68; new ed. 1888–92), are the principal British cyclopædias of the nineteenth century. The *Allgemeine Encyklopädie* of Ersch and Gruber (160 vols., 1818, *seq.*); Meyer's *Grosse Conversations-Lexikon* (52 vols., 1840–55); Pierer's *Universal-Lexikon* (34 vols., 1840–46; 5th ed. 19 vols., 1867–71); Brockhaus (13th ed. 1882–87) and Meyers' *Conversations-Lexikon* (16 vols. and 2 supps., 1885–91) are the best cyclopædias in German. Of the small encyclopædias, the *Hand-Lexicon* of Meyer (2 vols., 1892–93) is by far the best. The French have *Encyclopédie des Gens du Monde* (22 vols. 8vo, 1833–44); *Encyclopédie Moderne* (36 vols. 8vo, 1848–57); *Encyclopédie Catholique* (18 vols. and sup.); and Larousse, *Grand Dictionnaire Universelle du XIX*me *Siècle*, published in fifteen volumes, large quarto, with two supplementary volumes of the same size. This work was intended to replace the famous *Encyclopédie* of the eighteenth century (Paris, 1865–80). The later cyclopædias published in the U. S. have been *The New American Cyclopædia* (16 vols., 1857–63), revised as *The American Cyclopædia* (16 vols., 1873–76); Zell's *Encyclopædia* (2 vols. large 4to, 1869–72; an abridgment in 1 vol. 4to, 1872); *The National Encyclopædia* (8vo, 1872, *seq.*); an edition of Chambers's *Encyclopædia*, printed from imported plates (10 vols. 8vo); Schem's *German-American Encyclopædia* (8 vols., 1869); *Johnson's New Universal Cyclopædia* (4 imp. 8vo vols., 1874–77); *People's Cyclopædia of Universal Knowledge* (3 vols., 1881–83); *Johnson's New General Cyclopædia and Copper-plate Hand-atlas of the World* (2 vols. 8vo, 1885); *International Cyclopædia* (15 vols., 8vo, prepared on the basis of a former ed. of Chambers's); *Johnson's Universal Cyclopædia, Revised* (1893–99, 12 vols.). See also DICTIONARY, LEXICON, BIBLIOGRAPHY, and BIOGRAPHICAL DICTIONARIES.

Revised by C. K. ADAMS.

Endele'chius, SEVERUS SANCTUS: Christian Latin poet, perhaps from Gaul, who taught rhetoric at Rome toward the end of the fourth century. He is the author of an amœbean pastoral, relative to a murrain among cattle (*De Mortibus Boum*). Tityrus ascribes the preservation of his herd to the sign of the cross impressed upon their foreheads. See Riese's *Anthologia*, 893, and a separate edition by J. A. Giles (London, 1838).

M. WARREN.

Endellionite: See BOURNONITE.

Endemic [from Gr. ἐν, in + δῆμος, people]: peculiar to some locality; often occurring in a particular region; said of diseases. The investigations of endemic influences deal with climate, topography, geology, water-supply, personal habits and character, moral, religious, and political conditions, and (since the origin of the germ-theory of disease) with the study of minute animal and vegetable organisms. The study of endemic influences has given rise to the new science of medical geography. See Mühry, *Noso-Geographie* (2 vols.); Boudin, *Traité de Géographie et de Statistique Médicales, et de Maladies Endémiques* (2 vols., 1857); Sir Ranald Martin, *On the Influence of Tropical Climate*; the *British Army Medical Reports*, annual since 1859.

Endermic Method [*endermic* is from Gr. ἐν, in + δέρμα, skin]: a manner of administering medicines formerly sometimes employed, by which the skin was made to absorb the remedy used. In some instances a blister was raised, and the medicine—for example, sulphate of morphia—was applied to the blistered surface. This plan, though often surprisingly effective, has been superseded by the hypodermic method, in which the medicine is introduced under the skin by a small needle-pointed syringe.

Endicott, John: Colonial Governor of Massachusetts; b. at Dorchester, England, in 1589; removed to America in 1628, was acting Governor of the Massachusetts Bay Colony in 1629–30, and was elected to that office in 1644, again in 1649, and re-elected to it every year from 1650 to 1665, except in 1654. A bold and energetic man, a zealous Puritan, he was intolerant of whatever he considered wrong. To meet the needs of the colony he established a mint in spite of a law forbidding such action, and cut out the red cross of St. George from the military standard because, as he claimed, the emblem savored of popery. Under his administration, from 1659 to 1661, four Quakers who refused to obey the laws, which banished them from the colony, under pain of death if they returned, were put to death in Boston. D. in Boston, Mass., Mar. 15, 1665.

Endicott, William Crowninshield: lawyer; b. at Salem, Mass., Nov. 19, 1827; a lineal descendant of John Endicott and of Jacob Crowninshield, Secretary of the Navy in Jefferson's cabinet 1805–09. He studied law and was admitted to the Massachusetts bar in 1850; was a judge of the Supreme Court 1873–82; and was Secretary of War in the cabinet of President Cleveland 1885–89. D. May 6, 1900.

Endive [from Fr. *endive*: Ital. *endivia* < Lat. **intibea*, deriv. of *in'tibum*, *in'tibus*, or *in'tybum*, endive, chicory] (*Cicho'rium endi'via*): a biennial herbaceous plant of the family *Compositæ*, cultivated in the gardens of Europe and America. Its blanched radical leaves are used as a salad. It is a native of the Mediterranean basin.

Endless Screw: a piece of mechanism formed by combining the screw with a cog-wheel, or by making a screw act on the threads of a female screw sunk in the edge of a wheel. The axis of the screw may be either in the plane of the wheel or at right angles to it; in the latter case it is called the American endless screw. In its mechanical principle the endless screw is a combination of the inclined plane and the lever.

Endlicher, ent'lich-er, Stephen Ladislaus: botanist and linguist; b. at Pressburg, Hungary, June 24, 1804. He studied several Oriental languages and the natural sciences. In 1828 he became director of the Imperial Library of Vienna, and in 1840 Professor of Botany in the university of that city. Among his botanical works are *Genera Plantarum* (1836–40); *Iconographia Generum Plantarum* (1838); *Enchiridion Botanicum* (1841): and *Synopsis Coniferarum* (1847). D. in Vienna, Mar. 28, 1849.

Endocardi'tis [*endocardium* + *-itis*, of Greek origin, used in names of diseases to denote inflammation]: an inflammation of the endocardium. It is generally of rheumatic character, and, though not often immediately fatal, it is a frequent cause of organic disease and deformity of the heart and its valves. It is frequently associated with pericarditis, and its occurrence is one of the results always to be feared in rheumatic fever. It is usually attended by pain or discomfort about the heart, and is detected by auscultation. It produces peculiar murmurs in the heart, the significance of which can only be appreciated by the trained physician. The disease is very intractable. Sedatives, such as morphia, hydrocyanic acid or aconite, and digitalis, may be useful in acute stages. The alkaline treatment for rheumatism is often advantageous. Patients sometimes, though not very frequently, entirely recover.

Endocar'dium [from Gr. ἔνδον, within + καρδία, heart]: the serous membrane lining the chambers and valves of the heart.

Endocarp [from Gr. ἔνδον, within + καρπός, fruit]: the inner coat or layer of a fruit, as the stone of the cherry and peach. See Drupe.

Endochrome [from Gr. ἔνδον, within + χρῶμα, color]: an old name for the coloring-matters in plant-cells, including diatomin, phycocyanin, phycoerythrin, phycoxanthin, etc., all to be regarded as forms or modifications of Chlorophyll (*q. v.*).

Endogamy: See Ethnology.

En'dogens, or **Endog'enous Plants** [from Gr. ἔνδον, within + -γενης, produced; cf. ἐνδογενής, born in the house]: See Monocotyledons.

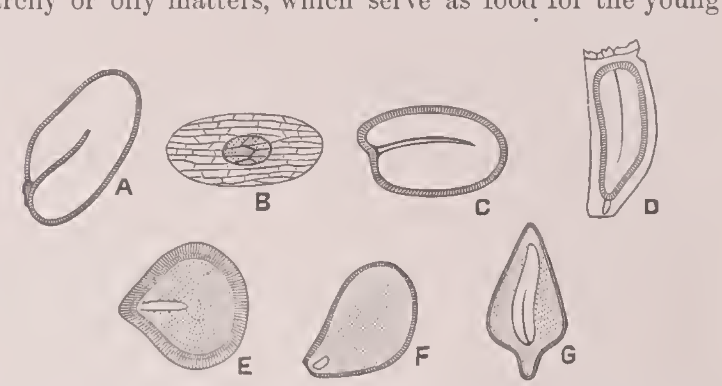
Endophlœum: See Bast.

En'dor: an ancient village of Palestine; on the northern declivity of Little Mt. Hermon, 18 miles S. E. of Acre (see map of Palestine, ref. 6–E); long held by the Canaanites against the Israelites, and celebrated as the scene of Saul's interview with the witch. (See 1 Samuel xxviii.) It contains about twenty rude houses and some cave-dwellings.

Endorse [readapted to Lat. original from Mid. Eng. *endosse* = O. Fr. *endosser*; *en* < Lat. *in* + *dosser*, deriv. of *dos*: Ital. *dosso* < Lat. *dorsum*, back—i. e. write upon the back]: in commercial law, to write one's name on the back of a note, check, bill of exchange, or the like, in order to transfer the property in it or the rights arising under it, or to guarantee its due satisfaction. See Indorse and Bill of Exchange.

Endosmo'sis and **Exosmosis**: See Liquid Diffusion.

En'dosperm [Gr. ἔνδον, within + σπέρμα, seed]: the cellular matter (formerly called *albumen*) surrounding or at the side of the embryo, and within the seed-coats of many seeds. It is developed in the embryo-sac of the seed after fertilization, and in many seeds is all absorbed before the ripening of the seed by the growing embryo (in seeds "without endosperm"); while in others only a part is so used (in seeds "with endosperm"). It is usually filled with starchy or oily matters, which serve as food for the young



A to D, seeds without endosperm; E to G, seeds with endosperm; A, Alisma; B, Orchis; C, Barbarea; D, Chicory; E, Iris; F, Ranunculus; G, Rumex.

plant during the period of germination. In wheat, oats, maize, buckwheat, etc., it is very starchy, and on being crushed yields flour. In a few seeds a starchy matter develops outside of the embryo-sac; this is distinguished as "perisperm." Charles E. Bessey.

Endym'ion (in Gr. Ἐνδυμίων): in Greek mythology, a beautiful youth beloved by Diana (Selene), who cast him into an everlasting sleep. One tradition represents him as a son of Zeus (Jupiter), who granted him immortality and the privilege of sleeping as much as he desired. Some persons suppose that Endymion is a personification of the sun or of the plunge of the setting sun into the sea.

Enemy [from O. Fr. *enemi* > Mod. Fr. *ennemi*: Ital. *nemico*: Span. *enemigo* < Lat. *inimi'cus*; *in*, not + *ami'cus*, friend]: in international law, a state which has publicly declared war against another state, or against which the latter state has made such a declaration. This declaration must be made by a duly organized state or kingdom, for such a declaration by any turbulent body of men is not sufficient. Hostilities having been formally declared, every subject or citizen of the hostile nations becomes in theory an enemy of the opposing state, and all intercourse or communication between the citizens of one hostile state and those of the other is unlawful. Thus the term enemy includes both combatants, to whom the actual combat is intrusted, and non-combatants, who are exempted from the operations of war as far as possible. An enemy can not, as a general rule, enter into any contract which can be enforced in the courts of law; except, for example, when a state permits expressly its own citizens to trade with the enemy; and perhaps a contract for necessaries or for money to enable the individual to get home, or for ransom, though not by English usage, might be enforced. In the U. S. an alien enemy can not, in general, sue, during the war, a citizen of the U. S., either in the federal courts or those of the several States. The word *enemy*, in a still more extended sense, includes all who have begun, or who have made preparations for beginning, hostilities against a state, or are participating in a war against a state, though their own state may be in amity with it. The Latins had a particular term (*hostis*) to denote a public enemy, and denoted a private enemy by the term *inimicus*. See War.

Revised by T. S. Woolsey.

Energy [from Gr. ἐνέργεια, force, activity, deriv. of ἐνεργής, active; ἐν, in + ἔργον, work]: an ideal physical quantity which serves as a common measure of certain forces or results of action in nature. There is a remarkable analogy between the ideas of energy and of matter, in that neither of them can be created or destroyed. When matter disappears from sight, for example, when water evaporates, its form is merely changed into that of an invisible vapor, which, if condensed, will again turn into the original quantity of water. At first sight it would seem that other things than matter can be created out of nothing, and lapse back again into nothingness, without any change of form. Motion is an example of this. A stone allowed to drop acquires motion; when it reaches the ground the motion ceases. So far as ordinary observation goes, nothing has been expended to make this motion, nor has the motion yielded anything that can afterward be used. So electricity can apparently be made out of nothing by rubbing two bodies together. When thus created it can apparently be destroyed without producing any result.

Modern research seems to indicate that these conclusions are not true, but that all physical effects are subject to the law of causation; that they can not be produced except by expending or using up a proportional quantity of some active agent, which may then be regarded as their cause. Thus arises the idea that the expenditure of the cause in producing an effect is simply a transformation of one thing into another, like that which takes place when water is transformed into vapor. This idea has been developed historically in the following way: When mechanics was reduced to a science, by applying mathematical analysis to Newton's law of motion, the following general theorem was discovered: Let there be any number of bodies (for example, those which compose the solar system) moving under the influence of their mutual gravitation, but never coming into actual collision. Conceive the following two quantities to be formed: (1) the sum of all the products obtained by multiplying the mass of each body into half the square of its velocity; (2) the sum of the quotients obtained by dividing the products of every pair of masses, taken two and two, by their mutual distance. In algebraic language, if we represent by m_1, m_2, m_3, etc., the masses of the bodies, the unit of mass being taken as that quantity of matter which will attract an equal quantity with unit force at unit distance; v_1, v_2, v_3, etc., the velocities with which the several bodies are moving at any instant; r_{12}, r_{13}, r_{23}, etc., the distances apart of the first body from the second, of the first from the third, of the second from the third, etc.; then if we represent the first quantity above defined by T and the second by P, their algebraic expressions will be

$$T = \tfrac{1}{2}(m_1v_1^2 + m_2v_2^2 + m_3v_3^2 + \text{etc.})$$
$$P = \frac{m_1m_2}{r_{12}} + \frac{m_1m_3}{r_{13}} + \frac{m_2m_3}{r_{23}} + \text{etc.}$$

In modern physics the quantity T is called the kinetic energy of the system of bodies.

Owing to the continually varying velocities of the bodies and their varying distances, the two quantities T and P are continually varying, but the conclusion of the theorem is that *their difference never varies* so long as no external force acts on the bodies. Thus we may write the equation

$$T - P = \text{a constant},$$
$$\text{or } T = P + C.$$

If the negative of P be regarded as the representative of another quantity, called the potential energy of the body, putting

$$E = \text{potential energy} = -P$$
$$\text{then } T + E = \text{a constant},$$

so that whenever T increases the potential energy will diminish by the same amount, and *vice versa*. Thus arises the conception that through all the motion of the bodies there is a transformation of one of these forms of energy into the other without any gain or loss. Such was the idea as developed by the geometers of the time of Lagrange and Laplace.

An apparent exception was seen to occur if two of the bodies came into collision. It was shown that then the kinetic energy T would be lost, without any potential energy being gained, so that there would be an apparent loss in the sum of the two. But Rumford showed that in such a case, although energy disappeared, something else took its place—namely, *heat*. That is, he showed that by using up energy, or the forces which could be changed into energy, a corresponding amount of heat could be produced. Thus if H be put for a quantity proportional to heat produced, there will result the equation

$$T + E + H = \text{constant}.$$

Subsequently Joule, and after him a number of experimenters, determined the exact amount of energy which had to disappear in order to obtain a given amount of heat. To explain the constant relation thus arising, the relation between energy and work must be shown.

Work is said to be done whenever a force acts upon a body in motion. The amount of work is equal to the product of the force into the distance through which the body is moved under its action. For example, if a weight of 1 lb. is raised to a height of 16 feet, an amount of work is done which may be called 16 foot-pounds. Suppose that the effect of this work is undone or annihilated by letting the body fall back through the 16 feet. Apparently when it reaches the ground the work is undone without any effect being produced. But really a certain quantity of heat has been generated by the blow in striking, and there is an exact correlation between the amount of the fall, the energy with which the body struck the ground, and the amount of heat generated. This relation may be expressed by saying that the temperature of the water at the bottom of Niagara Falls must be a quarter of a degree Fahrenheit higher than at the top, in consequence of the energy produced by the fall being changed into heat. The amount of heat generated or absorbed in various processes may be accurately measured, and a common measure is that necessary to raise a kilogramme of water from 0° C. to 1°C., called a CALORIE (*q. v.*). The instrument used in measurement is called a CALORIMETER (*q. v.*).

There are two forms of potential energy—the one, that already described, dependent on the positions of bodies, the other dependent on their internal constitution or chemical combinations. For example, let us touch with a flame a mixture of oxygen and hydrogen. An enormous amount of heat is instantly produced, apparently out of nothing. But the mixture of gases is changed into water, or, more precisely, into steam. We therefore conclude that oxygen and hydrogen, as pure gases, have stored up in them a definite quantity of potential energy which is spent or transformed into heat when they combine to form water. The truth of the theory is shown by the fact that the water requires the expenditure of a corresponding amount of energy in some other form to be decomposed into its elements. If it is decomposed by an electric current from a dynamo, then the amount of work done by the dynamo is the exact equivalent of the heat which was evolved by the combination of the gases and a condensation of the steam which they formed.

There is still a fourth form into which the three forms already described may be transformed, namely, electricity. To produce electricity of a given potential, one of the other forms of energy must be expended, or work of some kind, internal or external, must be done.

The general principles of the subject having been illustrated, certain more exact numerical statements respecting it are necessary. The various forms of the physical quantity called energy may be classified as follows:

(1) *Actual or kinetic energy*, exhibited whenever a body is set in motion, and measured by the product of the mass of the body into half the square of its velocity. (2) *Potential energy*, which means a quantity dependent on the position or internal state of a body, of such a nature that it changes by a certain amount whenever that condition or position changes. (3) *Work* done, which has already been defined as the product of a force acting upon a body into the distance through which the body moves in the direction of the force. Strictly, however, work should not be regarded as a distinct form of energy; it is simply the process of changing the amount of potential energy. (4) *Electricity*, or, to speak more exactly, electric potential. (5) *Heat*.

Each of these quantities may be taken to have a certain value or price in nature, as measured by the others. Their production and expenditure is then subject to the law that no one of them can be produced except at the expense of one or more of the others, and can never be annihilated except by producing one or more of the other four. They were formerly called *forces*, and the relations between them were called the *correlation of forces*.

The law that no energy is created or destroyed is called the law of *conservation of energy*. See ENERGY, CONSERVATION OF.

The operations of an electric railway run by a storage battery afford one of the best examples of the way in which these various forms of energy may be transmuted into each other. Begin with the fuel which heats the water in the engine. In this fuel, considered in relation to the oxygen in the atmosphere, is stored a certain definite amount of potential energy. By combustion this potential energy is changed into such a quantity of heat that every pound of coal burned creates heat enough to raise the temperature of 8,000 lb. of water one degree centigrade. If the heat thus applied to the water in the boiler were allowed to accumulate it would speedily burst it; but the water is first converted into steam. Part of the heat produced by the combustion thus disappears, and in its place appears a change of water into steam. This change involves an increase of potential energy exactly equivalent to the heat which has disappeared. The steam now drives the piston of the engine against the resistance of the machinery and of the currents in the dynamo, and in the act of doing so is changed back into water. A part of the potential energy which thus disappears is expended in heating the water of the condenser; the remainder in the work of running the dynamo, where it reappears as electricity. The electric current is now passed through the storage battery, where the potential energy disappears as fast as the dynamo creates it, and in its place a chemical change is produced in the materials of the battery, and this change is the exact equivalent of the heat which has disappeared. It must be understood that all the heat does not thus disappear; probably nine-tenths of it has been expended in heating the water in the condenser and in warming the air by the products of combustion, and only one-tenth has been utilized as actual potential energy. The storage battery thus charged with potential is put into the electric car. The moment the car begins to move the friction of the wheels acts against it, and work is done. This work is turned into heat by the friction of the car along the road, provided the latter is level; but if the car has to go up a hill, the work of raising the car against gravity has also to be done. Thus the potential of the storage battery disappears and in its place appear two physical effects—the production of heat and the raising of the car against the force of gravity. If the car runs down hill either more heat will be produced or the potential of the storage battery will be increased accordingly. The beautiful result is this: Supposing the storage battery of a car to have just enough potential energy to run the car all day and bring it back to its starting-place, the friction on the tracks will reproduce exactly the amount of heat which was generated in the combustion of the coal, less the amount which has been already reproduced in other ways, as by the friction of the engine, the heating of the dynamo, etc. But suppose that at night the car is at the top of a hill from the foot of which it started in the morning, and that the difference of level is 430 meters, then the heat which has been produced in all these ways will be less than that given out by the combustion of the coal by just enough to heat a quantity of water of the same weight as the car 1° C. or 1⅘° F. Now, let the car run to the bottom of the hill by its own weight and this lost heat will be reproduced by friction and by the act of stopping the car. To the eye of the physicist, all the operations of nature consist in transformations of energy from one form into another. The great storehouse of energy is the sun, which continually supplies it to our earth in the form of heat. A part of the heat is spent in evaporating the waters of the ocean, raising the clouds, and keeping up the processes of animal and vegetable life. When these processes cease, and when the clouds reach the ocean in the form of rivers, the heat is reproduced. The heat of the sun can not generally be utilized with advantage for driving ships and machinery except in the case of water-power. The heat which the sun radiates from a clear sky upon the deck of a steamship would suffice to drive her at a fair speed could it only be turned into work. But the practical difficulties in the transformation are insuperable. The work of machinery has therefore to be done by utilizing the potential energy stored up in the coal beneath the surface of the globe. See POTENTIAL. S. NEWCOMB.

Energy, Conservation of: the general law, developed in the article ENERGY, that no form of energy can ever be produced except by the expenditure of some other form, nor annihilated except by being reproduced in another form. Consequently, the sum total of energy in the universe, like the sum total of matter, must always remain the same. This law was formerly known as that of the *conservation of force*; but the ambiguity of the word force led to the use of the term "energy" to express the physical quantity in question. S. NEWCOMB.

Energy, Dissipation of: a general theory or phenomenon of physics first pointed out by Sir William Thomson, and bearing directly upon the nebular hypothesis, though quite independent of it. It may be expressed by saying that there is a constant tendency in all known forms of energy to be converted into heat, and that this heat radiates into space and is apparently lost forever. The great storehouse of energy is the sun, but its heat is being constantly radiated into space and never returned to it, so far as we can discover. Since the quantity of heat is limited, the time must arrive when the sun will become a cool, dark body like the earth. Even when heat is for the time being turned into power, this power ultimately disappears by the generation of heat through friction. This heat is communicated to the earth, air, and ocean, and radiated off into space. If any arrangement existed by which the heat could be returned to the earth or to the sun, we might imagine its ultimate recovery; but all the known laws of radiation lead to the conclusion that the lost heat goes off in straight lines through infinite space, never to be again recovered. This remarkable fact leads us to set both a beginning and an end to the existing order of things, but does not in itself explain the beginning. The only end to which it points is one in which life can no longer exist, the sun ceasing to give light or heat, and the earth and planets becoming cold in the embrace of death. S. NEWCOMB.

Enfantin, aăṅ'faăṅ'tăṅ', BARTHÉLEMY PROSPER: French socialist and leader of the Saint-Simonians; b. in Paris, Feb. 8, 1796. He was destined for the army and educated in the École Polytechnique; but when Louis XVIII. closed the school, in 1815, he sought employment in mercantile business. After traveling for several years in Russia, Germany, and the Netherlands as agent for a French winehouse, Enfantin entered a French banking-house in St. Petersburg in 1821, and became in 1823 cashier in the Caisse Hypothécaire in Paris. In 1825 he made the acquaintance of Saint-Simon, and was completely captivated by his ideas. Shortly after the death of the master he founded, together with a brother pupil, Olinde Rodriguez, a communistic paper, *Le Producteur*. Though the paper was stopped very soon, the sect continued spreading, and after the revolution of 1830 it was organized under the lead of Enfantin and Bazard. They soon came to represent widely divergent views, the former introducing novel ideas of moral and religious reform, the latter confining himself more strictly to the political and philosophical ends contemplated by Saint-Simon. At last Enfantin's declaration against marriage and in favor of free love caused a split in the organization, and his imprisonment in 1832 for offenses against public morality finally led to its dissolution. He afterward spent some years in Egypt, was appointed postmaster near Lyons in 1841, and director of the Paris-Lyons Railway in 1845, and founded the paper *Le Crédit* in 1850; but he continued true to the last to his ideas. Among his writings are *Doctrine de Saint-Simon* (1830); *Économie politique et Politique* (1831); *La vie éternelle* (1861); and a great number of articles in the papers. D. in Paris, Sept. 1, 1864.

Enfield: a town of Middlesex, England; on the London and Cambridge Railway; 10 miles N. of London (see map of England, ref. 12–J). Here is a large Government manufactory of small-arms. Pop. (1891) 31,532.

Enfield Rifle-musket: a variety of small-arms manufactured at Enfield, England, at the royal small-arms factories from 1853 to 1864. During the civil war in the U. S. the Federal and the Confederate Governments each purchased large quantities of these and other European arms on account of the difficulty of supplying the large numbers of troops with the necessary weapons. The Enfield rifle, though a very serviceable weapon, much better than the Belgian and Austrian arms then imported, was in almost every respect inferior to the old Springfield (U. S.) rifle-musket, which it much resembled. All these weapons have given place to various breech-loading arms.

Enfilade [Fr., deriv. of *enfiler*, to thread on a string; *en* (< Lat. *in*) + deriv. of *fil*, thread < Lat. *filum*]: a discharge of musketry or artillery made in a direction parallel to the length of a line of troops or of a line of rampart, so that the shot rakes the whole line. A trench or parapet is said to be *enfiladed* when guns are so placed that the shot can be fired into it in a direction coincident with its length.

Eng (right) and **Chang** (left): the Siamese Twins; b. at Bangesau, Siam, Apr. 15, 1811, the offspring of a Chinese father and a Chino-Siamese mother. They were brought to the U. S. in 1829, and after a number of tours of exhibition lived about twenty years as Eng and Chang Bunker near Mt. Airy, N. C., and died in Jan., 1874. They differed widely in appearance, character, and strength, performed their physical functions separately, and were addicted to

Eng and Chang (the Siamese Twins).

different habits, Chang being intemperate and irritable, Eng sober and patient. Both were married and had large families of children, a number of whom died young, but none exhibited any malformation. Chang received a paralytic stroke in Aug., 1870. He died unexpectedly while his brother was asleep, and Eng died a few hours afterward, probably chiefly from the nervous shock on learning the sudden death of his brother. They are the best known of the "double monsters" on record, none others of whom ever lived to the advanced age of sixty-three.

The connection of the Siamese twins was near the navel. The connecting band was a few inches long, after having elongated a little during the long life of the twins, and 8 inches in circumference (2½ in diameter). Inside the skin there was normal subcutaneous and muscular tissue, portions of the muscles of one crossing those of the other. The interior was occupied by the prolongations of the peritoneum crossing from one to the other.

The livers of the twins were located in close proximity to the connecting band, and connected with each other by small blood-vessels, which were lined with a thin layer of genuine liver tissue. It is possible that by operation the twins might have been separated, though the necessary injury to the peritoneum of both and the division of the connecting blood-vessels and accompanying liver tissue might easily have led to a fatal result.

Revised by William Pepper.

Engadine, en-ga-deen', or **Engadin**: the upper part of the valley of the river Inn, in the canton of Grisons, Switzerland; about 65 miles long, with an average width of 1½ miles; separated by the noble Bernina Mountains from the Valtelline. For 30 miles the mean height is 5,500 feet above sea-level, while the village of St. Moritz on the banks of the Inn is at a height of 6,090 feet. The climate, which is very cold, even in the summer, has been found very beneficial to certain classes of invalids, and the Engadine has become a popular resort for European tourists, who are attracted as well by the great beauty of the valley, especially of the Upper Engadine. The inhabitants, a pious, simple class of peasants mostly of the Protestant faith, number about 12,000, and speak a peculiar Romanic dialect, called Ladin. The young men are known throughout Europe as good confectioners and coffee-house keepers. They usually amass a competence, and return to enjoy their small fortunes in their native valley. The government is a pure democracy.

Engano, en-gaa'nō: an island of the Malay Archipelago; lat. 5° 21' S., lon. 102° 20' E.; 75 miles from the southwest coast of Sumatra. It has an area of 128 sq. miles, and is rather high and well wooded. The people are of Malay race, and are included in the Dutch Sumatran government of Benkulen. The island has a good harbor, but is mostly surrounded by coral-reefs. Pop. 6,400.

Engedi, en-ged'ē [Heb. *Eyn Gedi*, spring of the king]: a town several times mentioned in the Bible (e. g. Josh. xv. 62; Song i. 14; Ezek. xlvii. 10), and also called *Hazezon-tamar* (city of palm-trees, Gen. xiv. 7), alluding to its palm-trees, which have now disappeared. It stood, as its ruins show, on the west side of the Dead Sea, at a point about equally distant from its north and south extremities, and in a very fertile spot near the fine fountain which gave it a name. There are numerous caves in the vicinity. These served as hiding-places for David (1 Sam. xxiv. 1–4) and his followers in the days of their outlawry during the reign of Saul.

Eng'el, Ernst: statistician; b. in Dresden, Germany, Mar. 26, 1821; studied in Freiburg and later in Paris; had charge of the bureau of statistics in Dresden for nearly a decade; in 1860 became a director of the bureau of statistics in Berlin; and in 1863 presided at the International Statistical Congress in Berlin. He published the *Zeitschrift des statistischen Bureau* (begun in 1860); the *Jahrbuch für die amtliche Statistik des Preussischen Staates* (1865–76); *Preussische Statistik* (begun in 1861); and numerous other statistical works. He retired from Prussian service in 1882, and removed to Oberlössnitz, near Dresden. D. Dec. 8, 1896.

Engel, Johann Jakob: author; b. at Parchim, in Mecklenburg, Germany, Sept. 11, 1741; educated in Rostock, Bützow, and Leipzig; became Professor of Belles-Lettres in Berlin in 1776. Among his works are *Ideen zu einer Mimic* (2 vols., 1785), and *Lorenz Stark* (1795), a romance which was very popular. His works are characterized by a refined taste and elegance of diction. D. at Parchim, June 28, 1802.

Engel, Joseph: anatomist; b. in Vienna, Jan. 29, 1816; educated in Vienna; became Professor of Descriptive Anatomy at the University of Zurich in 1844, Professor of Pathological Anatomy in Prague in 1849, and of Descriptive Anatomy at the Joseph Academy in Vienna in 1854. He published, among other works, *Specielle pathologische Anatomie* (1856); *Das Knochengerüst des Menschlichen Antlitzes* (1850); *Compendium der topographischen Anatomie* (1859); and *Allgemeine pathologische Anatomie* (1865).

Engelberg, eng'el-bārch: village of the canton of Unterwalden, Switzerland; in Engelberg valley, at the foot of Mt. Titlis (see map of Switzerland, ref. 5–F). It is famous for its school, which is connected with a stately Benedictine abbey, *Mons Angelorum*, founded by Pope Calixtus II. in 1120, and rebuilt in 1729. It has a good library of old works and some valuable paintings. Here is also a famous cheese-cellar of great extent. Pop. (1888) 1,973.

Engelbert: a Benedictine author of noble parentage; abbot of Admont in Styria; b. about 1250; educated at Prague and Padua; became abbot in 1297. Of his numerous works the most important was a Roman history, *De ortu, progressu et fine imperii Romani*, published in 1553, 1610, and later. Several theological tractates of his production have been published by Pez, with a biography and a full list of his works. D. in 1331.

Engelbert, Saint: son of Engelbert, Count of Berg, and of Margaretha, daughter of the Count of Geldern; b. in 1185; studied at Cologne; was chosen cathedral provost in 1199, but was deposed in 1206 and not restored for two years. He repented of his lax life and became strict. In 1216 he became Archbishop of Cologne and elector of the empire of Germany, having when twenty-two years old declined the bishopric of Münster. He paid off the debt of the electorate, enlarged its territories, and reformed its administration. When the Emperor Frederick II. went to Italy, Engelbert was the principal regent in Germany. He reformed the corrupt clergy, checked the power of the nobles, and zealously advanced that of the Church. His energy and rigor made many enemies, and he was murdered by his own nephew at Gevelsberg, near Schwelm, Westphalia, Nov. 7, 1225. The murderer, Count von Isenburg, was broken on the wheel, and his accomplices, the Bishops of Osnabrück and Münster, received excommunication. St. Engelbert is one of the characteristic figures of German mediæval history, recalling Saints Dunstan and Thomas Becket, but he seems to have possessed more zeal for the purity of the Church than they showed, and an energy equal to theirs in extending its power. His life was written by Cæsar, of Heisterbach, first published in 1570, best ed. by J. F. Bohmer (*Fontes rerum Germanicarum*, Stuttgart, 1843, *sqq.*, vol. ii.), and by J. Ficker (Cologne, 1853).

Engelbrecht, eng'el-brecht, JOHANN: religious enthusiast; b. at Brunswick, Germany, in 1599. He was a tailor's son, and worked at his father's trade until his health failed. He was liable to cataleptic attacks, during which he went for many days without food or drink. In 1622 he set himself up for a prophet, in all sincerity regarding himself as a divinely inspired teacher. His writings have been in part translated into English. (*The German Lazarus*, London, 1707; *The Divine Visions of Johann Engelbrecht*, 2 vols., Northampton, 1780.) Though he was quite unlettered, some of Engelbrecht's books, like his addresses, display considerable power and an insight into spiritual things. After suffering imprisonment and enduring much obloquy, he retired from public life and died in 1642.

Engelmann, GEORGE, M. D.: botanist; b. at Frankfort-on-the-Main, Feb. 2, 1809; educated at Heidelberg, Berlin, and Würzburg; for a time was connected with the University of Berlin; in 1832 emigrated to the U. S., and in 1835 settled in St. Louis, Mo., where he became prominent as a physician. In 1836 he founded *Das Westland*, a newspaper which became well known by reason of its excellent articles on life and manners in the U. S. As a botanist Dr. Engelmann became more widely known. He devoted especial attention to North American vines, and to studies of the cacti, dodders, rushes, spurges, pines, and other difficult groups, many of his papers, which in all number about 100, appearing in Government reports. His herbarium and library became the property of the Missouri Botanical Garden at St. Louis. D. in St. Louis, Feb. 4, 1884.

Eng'elstoft, CHRISTIAN THORNING: theologian; b. in Næsberg, Denmark, Aug. 8, 1805; became in 1845 Professor of Theology at the University of Copenhagen, and in 1851 Bishop of Fühnen. He wrote, among other works, a *Reformantes et catholici tempore quo sacra emendata sunt in Dania concertantes* (1836); *Liturgiens eller Altertogens og Kirkeritualets historiei Danemark* (1841); *Taller ved forskjellije Keleigheder* (1858).

Enghien, aan'gi-ăn': a town of Belgium, province of Hainaut; about 20 miles S. W. of Brussels, with which it is connected by railway (see map of Holland and Belgium, ref. 10–D). It has a superb château of the Aremberg family, and manufactures of cotton and linen fabrics. The family of Bourbon-Condé derived from it the title of duke. The Great Condé was styled in his youth Duc d'Enghien. Pop. (1891) 4,313.

Enghien, LOUIS ANTOINE HENRI DE BOURBON, Duc d': French prince; b. at Chantilly, Aug. 2, 1772; eldest son of the Duke of Bourbon. He became an ÉMIGRÉ (*q. v.*) in 1789, and joined in 1792 the army of the Prince of Condé, who was his grandfather. He fought against the French republic until 1799. In 1804 he married the Princess Charlotte of Rohan-Rochefort, and became a resident of Ettenheim in Baden. Here he was seized by the order of Bonaparte, carried to Vincennes, tried by a military court, and shot Mar. 21, 1804, on the pretext that he was an accomplice of Cadoudal in a conspiracy against Bonaparte. This act excited great indignation, as it was generally believed that D'Enghien was not guilty.

Engine [from O. Fr. *engin*, cunning, machine: Ital. *ingegno* < Lat. *inge'nium*, talent, sense, skill]: any contrivance for the production of a mechanical effect, although the word is commonly applied only to the heavier and more powerful classes of machinery, and especially to the prime motors, as the heat-engines, air, gas, and steam engines, having some complexity of structure. Such contrivances as windmills and water-wheels are less frequently called engines, but might properly be so designated.

The usual conception has come to be a "train of mechanism," consisting of several elementary parts so "paired" and enchained that their motion must be mutually dependent and synchronous, and of fixed relative range and power. In this sense the engine is a contrivance for the performance of a specified task in a specified manner through the operation of one or more series of connected parts, driven from a source of energy, and applying that energy more or less efficiently to that act or series of acts which constitute the specific task of the machine. The prime movers best illustrate this definition, and the term, unqualified, has come to have this signification, popularly.

Engines may be classed as (*a*) prime movers, (*b*) secondary motors, (*c*) machines transmitting energy from motor to a follower, and (*d*) machines performing special tasks. These several classes are illustrated by (*a*) the heat-engines, (*b*) compressed-air engines, (*c*) dynamometers of the transmission kind, and (*d*) machine-tools, spinning-machines and looms, or other mechanisms substituted for manual labor. In the early days of the steam-engine, when Savery introduced his plan of construction, it was recognized as an improvement upon Worcester's *fire-engine*; Newcomen displaced this machine by his *atmospheric steam-engine*; and all later machines of this class have been known as steam-engines. The common machinist's lathe is often called an *engine-lathe*; Blanchard invented the *engine* for turning irregular forms; the engraver employs the "rose-engine" to produce certain geometrical patterns, and this machine is also called the geometrical *lathe*, or engine. Electro-dynamic machinery includes the electro-dynamic *engine*, which is sometimes substituted for the steam-engine or the water-wheel, supplying power from the electric current, instead of from thermodynamic or hydraulic sources. The ancients called their catapults and other machines used in warfare *engines of war*. The term has now come to convey so universally the idea of power and means of conveying or of applying power that it has taken many figurative aspects, and a plan, a method, or an artifice is often spoken of as an engine. Bacon speaks of the edict of Julianus as a "pernicious *engine*" against the Christian faith, and elsewhere of the state as a great *engine*. Thomson and Tait speak of the earth and sun as together constituting a "thermodynamic *engine*." In some cases the term takes a technical and limited meaning, as when the locomotive is mentioned, usually, not as a locomotive engine, but as an *engine*.

Engines are sometimes combined in pairs in the same class, as when Savery erected his "fire-engines" in the neighborhood of Manchester, England, to drive water-wheels, the latter, in turn, to drive the machinery of mills, and where Papin applied the same device to impelling the paddle-wheels of his steamboat of 1707.

Hydraulic engines are usually machines constructed very much like the steam-engine, but employing the pressure of water under a high head, natural or artificial. They are not applicable under low heads.

See STEAM-ENGINE, HYDRAULIC ENGINE, WINDMILLS, ELECTRICITY, and MACHINE-TOOLS. R. H. THURSTON.

Engineer: one who constructs or operates engines. "The engineer is he who, by art and science, makes the mechanical properties of matter serve the ends of man," as it is put by Rankine. In the most modern sense, the engineer is a person skilled in both the science and the art of some department of construction, as in either of the grand divisions described in the article on ENGINEERING (*q. v.*), and the specific or special branch pursued by him professionally gives the specific name to the engineer, as the military, the naval, the civil, the mining, the mechanical engineer. The accomplished engineer, as now bred in the technical or engineering school or college, and as perfected in his professional capacity by experience, must be conversant with applied mathematics, especially applied mechanics; with the physical sciences, especially the chemistry of materials and their preparation for use, and the physics of heat and electricity; with the principles of design and proportioning parts of structures and complete constructions; and with the best and most permanently economical methods of adapting and applying such constructions to their defined purposes under exactly prescribed conditions of work and wear. As no one person can accomplish this with reference to the whole range of engineering, he can only become professionally successful by securing, first, a general knowledge of the fundamental principles, facts, and methods, and then making himself familiar with the details of some single line of professional practice.

The *arts* of engineering, upon which the profession is as essentially based as upon scientific principles, are the trades which are utilized in the various branches of construction, as carpentry, masonry, forging, founding, machinist work, boiler-making, surveying, gun-making, armor-plate making. Every engineer must be sufficiently familiar with such of these trades as he is required to employ in his own work to secure good work, and rapid and economical construction.

This usually implies a practical knowledge and even, in some departments, experience in the art so applied. It is for this reason customary to teach something of the arts subsidiary to engineering as an advanced system of "manual training" in the schools of engineering. R. H. Thurston.

Engineering: the art of construction. During the earlier periods of the history of engineering all constructions were directed by men of rank, who were also necessarily soldiers, and were usually military officers, but as civil constructions became more general, and as the military element fell into the background, the art was more and more generally applied to the provision of the needs of the people in times of peace, and finally came to be divided into two grand departments, civil engineering and military engineering. Up to the early part of the nineteenth century civil engineering included the building both of structures and of machinery, and Smeaton, the greatest engineer of his time and a contemporary of Watt, constructed roads, bridges, aqueducts, canals, harbors, and other hydraulic works, and also became famous for his success in the building of steam-engines. The extensive introduction of the now familiar forms of motors, as heat-engines and water-wheels, and the innumerable machines used in the textile manufactures rendered the extent of the art too great for any one man to compass, and it gradually came to be recognized that civil engineering must be further divided, and mechanical engineering became known as the division relating to the construction of all kinds of machinery, the designation civil engineering becoming thus restricted to that department which has to do with static as distinguished from dynamic constructions. Still later, the development of the applications of electric energy and the construction of electrical apparatus and machinery have led to the separation of this branch from the older division of mechanical engineering, and "electrical engineering" has come to be another important subdivision of the art of engineering. The following classifications may meet the requirements of modern times as logically as any, but the continual increase in the complexity of construction is constantly modifying the relative extent and character of these various branches of the great constructive profession, and it is impossible to say what will be their final form:

Military Engineering.—The construction of works for offensive and defensive warfare, including the two main divisions, army or military engineering proper, and naval engineering, including the construction of engines, ships, and armor, and, in both sections, the construction of ordnance, which last is almost a profession by itself.

Civil engineering, now restricted largely by the assignment of other branches to special departments; the construction of "public works," as railroads, canals, harbors, and bridges.

Mining Engineering.—That department which assumes charge of all mining construction and operations from the preliminary location to the final operation of the completely organized and working establishment.

Mechanical Engineering.—The designing and construction of all forms of machinery. This is sometimes termed, in contradistinction with the preceding, "dynamic" engineering, as having to do only with moving structures, while civil engineering, concerned mainly with permanent structures, is sometimes called "static" engineering.

Electrical Engineering.—A modern branch or offshoot of mechanical engineering, dealing with the design, construction, and operation of the mechanism employed in the production, transmission, and utilization of electrical energy, as derived by transformation from some other form of energy, through an appropriate system of "prime motors."

Architecture should probably be classed as a branch of engineering, in which are combined the arts of carpentry and general construction with the fine arts, which latter are essential in all successful architecture in decoration. Civil engineering and architecture are often classed together.

The profession of engineering thus has for its province the construction of all classes of important works, whether static or dynamic, civil or military, public or private. It has for its basis the constructive *arts*, and for its code the principles of applied mechanics and the physical sciences. Its origin dates back to the prehistoric period when smiths, in the person of Vulcan, were deified, and to the days of Tubal Cain, "who was an artificer in brass and in iron." The Temple of Karnac, the Egyptian pyramids, the Roman roads and water-works, the Saracenic constructions of Southern Europe, and later public works, illustrate the progress of the art and its sciences. In the earlier days engineering was monopolized by the rulers of nations for the purposes of promoting their conquests, and military engineering thus antedated the engineering of civil life. While the engineer of modern times is neither an artificer nor a man of science, yet he is required to be so familiar with the arts and trades that he may direct constructions and distinguish good work, and, if needs be, show how he expects work to be done. He is also expected to be so familiar with mathematics and the physical sciences that he may readily make application of the principles of the sciences to the purposes of the work in hand. This is well illustrated in the case of electrical engineering, for example, by the fact that the engineer must in this case be an electrician as well; in marine engineering the engineer must be familiar with the principles of wave-motion, of fluid friction, and of resistances of "ship-shape" forms, as well as with the art of ship-building and marine-engine designing, embodying, as does the latter, the principles of chemistry, of heat-production, and of applied thermodynamics, as well as of the strength and proportions of the elements of machinery.

The training of the engineer, in modern times, is begun in the technical schools, and he is there taught the sciences and often something of the arts which underlie his profession. These schools usually offer more difficult and engrossing courses of instruction than the older institutions of learning, and exact severe work of their students, the general result being the elimination of those unfitted for the work and the final entrance into the profession of but a small proportion of all aspirants entering them. The profession has come to be fully the equal, in respect to preparation by special education, of the other so-called "learned professions," and, in respect to adaptation by selection, is in advance of either of its older congeners. Specialization is going on so rapidly, in consequence of the development of the arts and sciences and their more general application to the purposes of modern life, that the subdivision above indidicated is continually becoming more and more marked, and even in any one branch, as civil engineering, a practitioner, as a rule, is compelled to confine himself to some single subdivision, as to bridge-building, to railway work, to canal construction, or to harbor improvement, and having himself comparatively little knowledge of the art of building mechanisms, commonly goes to the mechanical engineer for his machinery. In mechanical engineering, similarly, the practitioner, who as a rule has little "expert knowledge" of roads or canals, takes up as a specialty either the design or construction of the steam-engine, the building of hydraulic motors and machinery, the construction of locomotives, or the application of energy through electrical transmissions from the prime motor. Only the specialist in engineering is usually fully successful.

R. H. Thurston.

Engineering, Experimental: the investigation of problems arising in the practice of the engineer. Since about the middle of the nineteenth century this has become a department of professional work of exceptional importance, and researches in applied science are regarded as essential to success in the improvement of the arts subsidiary to engineering. In modern technical schools the course of instruction, where systematically arranged, usually includes investigations in regard to the strength and other valuable properties of the material employed in engineering construction and in the operation of machines, e. g. wood and the metals, oils and the fuels; investigations in regard to the effect of stress and strain upon structures or on the elements of structures and machines; test-trials of heat-engines, water-wheels, dynamo-electric machinery, and other apparatus, in order to ascertain the distribution and the extent of the utilization or waste of energy in their operation under known conditions, etc.

At first work of this kind was carried on in what were known as "mechanical laboratories" attached to a few of the older technical schools, mainly for research and commercial gain rather than for purposes of instruction. The first in the U. S. was established by the writer in a small way in 1872, and results of researches were made public in 1873. At the organization in 1885 of the Sibley College of Mechanical Engineering and the Mechanic Arts at Cornell University, experimental engineering was made a part of the courses of undergraduate instruction, and now all important technical schools include such courses of instruction. Some European laboratories have been longer established than those of the U. S., but are mainly for research, and seldom, if at all, intended for the instruction of students in engineering.

See R. C. Carpenter's *Experimental Engineering*, which illustrates the courses of instruction in Sibley College; the treatise of W. C. Unwin on the laboratory work at South Kensington, London; and the works of the writer on the *Materials of Engineering*, in which the apparatus and methods of such instruction and such research are described and the results of their employment are illustrated.

R. H. Thurston.

Engineering Laboratory: See Laboratory, Engineering.

Engineers, Corps of: the branch of an army having charge of the engineering operations involved in war. Among all modern nations assuming to be military powers, the engineering service is organized into separate corps (see Engineering), and for the training of *élèves* for service in them, special military schools are generally provided. (For information as to the organization of these corps see Heydt, *Recherches sur l'organisation du Corps du Génie en Europe.*) In the U. S. the existing Corps of Engineers owes its origin to the act of Congress of Mar. 16, 1802, by which the President was authorized to organize and establish a Corps of Engineers, which was (ultimately) to consist of 1 colonel, 1 lieutenant-colonel, 2 majors, 4 captains, 4 first lieutenants, 4 second lieutenants, and a limited number of cadets (i. e. the *total* number not to exceed 20); and it was further provided that the said corps, when so organized, shall be stationed at West Point, in the State of New York, and shall constitute a Military Academy; and the engineers, assistant engineers, and the cadets of the said corps shall be subject at all times to do duty in such places and on such service as the President of the U. S. shall direct. Thus by their common organic law the Corps of Engineers and the Military Academy were *identical*. The sixty-third Article of War (Apr. 10, 1806) says: "The functions of the engineers being generally confined to the most elevated branch of military science, they are not to assume, nor are they subject to be ordered on, any duty beyond the line of their immediate profession, except by the special order of the President of the U. S.," etc.

Many of the officers of the newly created corps were soon called to duties along the seaboard in constructing fortifications, while, as the wants of the service and of the academy have become more clearly recognized, the number of cadets has been increased, to supply not only the engineers and artillery, but officers of all arms of the service; and the various professorships and departments of instruction now existing have been established at the academy.

In 1838 (July 5) the corps was increased to number forty-seven officers, and at the same time a corps of Topographical Engineers of about the same number (engineers under the designation having been before authorized) was organized. In 1846 (May 15) a company of "sappers, miners, and pontoniers" was authorized to be "attached to and compose a part of the Corps of Engineers, and be officered by officers of that corps, as at present organized; they shall be instructed in and perform all the duties of sappers, miners, and pontoniers, and shall aid in giving practical instructions in these branches at the Military Academy," etc. With some slight changes these corps were thus constituted at the commencement of the civil war. In 1861 three additional companies of engineer soldiers were authorized by Congress, which, with that already existing, were styled the "battalion of engineers"; and a company was also organized for the Corps of Topographical Engineers. In 1863 the latter corps was abolished, and its officers merged with the Corps of Engineers, the organization of which, as confirmed by the peace establishment of 1866, is 1 chief of engineers, with the rank, pay, and emoluments of a brigadier-general; 6 colonels, 12 lieutenant-colonels, 24 majors, 30 captains, and 26 first and 10 second lieutenants. Under this organization the Corps of Engineers, embracing its commissioned officers and companies of sappers, miners, and pontoniers, constitutes a special arm of the service, and is charged with all duties relating to the selection, purchase, and survey of the sites, and the plan, construction, and repair of all fortifications, whether permanent or temporary, and their care when not garrisoned; with all channel and river obstructions, including torpedoes, required for coast defense; with all works for the attack and defense of places; with all fixed and movable bridges for the passage of rivers; with all lines, redoubts, intrenched camps, bridge-heads, etc., required for the movements and operations of armies in the field; and with making such reconnoissances and surveys as may be required for these objects. It is also charged with the survey, plan, and construction of harbor and river improvements; with military and geographical explorations, reconnoissances, and surveys, including the geodetic survey of the lakes; and with all engineer duties confided to other departments than that of war, which may be specially assigned to the corps by acts of Congress or orders of the President of the U. S.

By act of Congress of July 13, 1866, the superintendency of the Military Academy, which had still been confined to the corps, was opened to all arms of the service; and at that date the intimate connection between the academy and the corps with which it was originally identified may be said to have terminated. See Willet's Point.

England (in Lat. *Anglia*; Fr. *Angleterre*; Germ. *England*): that part of the island of Great Britain which lies S. of Scotland and E. of Wales. It has an area of 50,823 sq. miles, is divided into forty counties, and is the principal member of the United Kingdom of Great Britain and Ireland. This is England proper, but the name England sometimes includes Wales, which for administrative purposes was united to England in 1535, and both are treated in this article. All that belongs to the United Kingdom at large, its geography and statistics, as well as its history from the time when the permanent union of Scotland with England and Ireland united the three countries into one empire, will be treated of under the head of Great Britain (*q. v.*).

England (in this extended sense) is bounded N. by Scotland, E. by the German Ocean, S. by the Straits of Dover and the English Channel, S. W. by the Atlantic, and W. by St. George's Channel and the Irish Sea. It is situated between lat. 49° 57′ and 55° 47′ N., and lon. 1° 46′ E. and 5° 41′ W., the greatest length N. and S. being 400 miles, and the greatest breadth 280 miles. In shape it resembles a triangle, of which Berwick may be considered the apex, and a line from the Land's End to the North Foreland the base. The area amounts to 58,186 sq. miles, of which 7,363 belong to Wales and 50,823 to England proper.

Coast.—The seacoast, if measured from one headland to another, is about 1,200 miles in length, but if the principal indentations are followed, about 1,900 miles. No place in the country lies at a greater distance from the sea than 70 miles. Its features exhibit largely the geological structure of the country. The eastern coast is unbroken, and there are only few bays or natural harbors affording shelter to shipping, a deficiency compensated for to some extent by the existence of several estuaries of rivers, among which the Humber and Thames are the most important. A flat shore predominates, and where cliffs occur they are, as a rule, composed of chalk, sand, or clay, which offer but little resistance to the destructive action of the waves. All around the sand-choked bay called the Wash, the Fens form an extensive marshland. In many parts the sea has encroached upon the land, but elsewhere considerable tracts of country have been recovered from the sea, and are defended against its onslaughts by dikes and embankments.

The western coast opens out upon the Irish Sea and the open Atlantic, and its features are far more diversified than on the east. Three broad bays open into the Irish Sea—viz., the Solway Firth, Morecambe Bay, and Liverpool Bay (with the estuaries of Mersey and Dee). They all abound in sandbanks, which render navigation exceedingly intricate. The peninsula of Wales has generally bold and rugged coasts. Menai Strait, hardly 600 feet in width, separates it from the island of Anglesey. The wide sweep of Cardigan Bay opens here toward the W., and Milford Haven penetrates far inland toward the S. W. This is one of the most secure harbors of the British islands, though, owing to its geographical position, it is but little used. Bristol Channel and the estuary of the Severn separate South Wales from the counties of Somerset and Devon. The most important bays along it are those of Carmarthen and Swansea on the coast of Wales, and of Barnstaple on the coast of Devonshire. The navigation of its upper portion is obstructed by sandbanks. Devon and Cornwall form a peninsula, terminating in the Land's End (50° 4′ N., 5° 42′ W.), the most westerly point of England. The Scilly islands lie off this cape, and have proved fatal to many a homeward-bound merchantman. The coasts of this peninsula are generally steep, and celebrated for their picturesqueness. There are several excellent harbors, among which we may mention Mount's Bay, the harbor of Falmouth, and Plymouth Sound; the last is protected by a magnificent breakwater, and the celebrated Eddystone lighthouse points out the way to it. The remainder of the south coast of England is generally level. The Bill of Portland, a rocky promontory joined to the mainland by the Chesil Bank, bounds the roadstead of that name to the W. The only other secure harbors on the south coast are those of Southampton and of Portsmouth, opposite the Isle of Wight, the latter the most important naval station of Great Britain. Spithead is a secure roadstead between it and the Isle of Wight. Farther to the E. the South Downs gradually approach the coast and form the bold Beachy Head (564 feet). The coast then again becomes level and, at Dungeness, marshy, but from Sandgate to the North Foreland it is formed of white chalk cliffs. These "white cliffs of Old England" have become proverbial, though their extent is very limited. They owe their prominence in the popular estimation principally to the fact of their first meeting the eye of a traveler coming from the Continent.* There are no natural harbors along this coast (that of Dover has been created artificially), but the roadstead called the "Downs," lying between the land and the Goodwin Sands, offers some shelter to shipping. The estuary of the Thames is bounded by low coasts, and sandbanks render its navigation exceedingly intricate. The estuary of the Medway, which opens into it, forms one of the most secure harbors, and has been strongly fortified. See CHATHAM.

RELIEF.—The surface, as a rule, is undulating. Toward the sea the country occasionally broadens out into plains, while furze-clad hills of no inconsiderable height rise in the north, in Wales, and in the southwestern parts of the country. Loveliness rather than grandeur is the distinctive feature of English scenery—verdant plains, carefully kept fields inclosed within living hedges, clumps and groves of trees, and numerous gently flowing rivers and rivulets.

Northern England, from the foot of the Cheviots (which separate it from Scotland) to the middle of Stafford and Derbyshire, is intersected by a range of mountains forming the water-parting between the German Ocean and the Irish Sea. By geographers these mountains are called the Pennine chain; locally they are known by a great variety of designations. The depression which separates this hilly region from the Cheviots is marked by the line of the old Roman wall which extended from Carlisle to Newcastle, and only rises 445 feet above the level of the sea. The Pennines divide themselves into two groups, separated by a depression at the heads of the rivers Ribble and Aire, where the Liverpool and Leeds Canal crosses them at an elevation of 500 feet. The northernmost of these groups culminates in the Cross Fell (2,892 feet), and is but loosely connected with the picturesque Cumbrian Mountains toward the W., which abound in lakes, shady woods, and rich pastures. Scafell Pike (3,216 feet), the highest summit of the Cumbrian Mountains, is at the same time the culminating point of all England. The southern group of the Pennine chain is far less elevated than the northern, and the Peak of Derbyshire, its culminating point, only rises to a height of 2,080 feet. It terminates with the Weaver Hill, in lat. 53° N. (1,154 feet). The region of the Pennine Mountains is one of the most sterile of England, and its moorlands are of great extent. In the rest of England there are no hill-ranges equal in importance to the Pennine chain, and the general level of the central portions of the country even but rarely exceeds 500 feet in height. The bands of lias and oölite which extend from Yorkshire to Dorset form a series of hills, interrupted by table-lands or plains, and having generally a steep escarpment to the W., and sloping down gently toward the E. Among these may be mentioned the North York moors (1,489 feet), to the N. of the Ouse; the Lincoln Heights, to the S. of it; the Cotswold Hills (1,134 feet), to the E. of the Severn; and the Dorset Heights. The valley of the Thames is bounded on the N. and S. by chalk hills, affording generally excellent pasturage. Those on the N. extend from Wiltshire into Suffolk, and attain an elevation of 904 feet in Wendower Hill. The southern chalk hills are known as the Downs, and attain scarcely an elevation of 1,000 feet; Inkpen Beacon (1,011 feet), on the boundary of Hants and Berks, is their culminating point. The Northern Downs (Leith Hill, 965 feet) extend from it to the coast of Kent, at Dover, where they form white cliffs; the Southern Downs terminate in the Beachy Head (564 feet), on the coast of Sussex. These two ranges bound a fertile region called the Weald, formerly a forest of oak, at present one of the most productive agricultural districts of the country. Geologists describe the Weald as a valley of denudation, and frequently refer to it in illustration of that kind of geological action. The Mendip Hills (1,067 feet), near the mouth of the Severn, are already beyond the chalk region of Southern England, for they consist of mountain limestone, and the Exmoor (1,407 feet), a range on the southern shore of the Bristol Channel, consists of Devonian rocks, which, with members of the Carboniferous series, occupy the greater portion of Devonshire and Cornwall, and are intruded by granite and other igneous rocks. To this intrusion is due the origin of the so-called "Dartmoor Forest," a desolate moor region rising in Yes Tor to a height of 2,077 feet. The fertile plain of Cheshire and the valley of the Severn form the natural boundary between England and the mountain region of Wales, next to Scotland the most considerable in the British islands. It is frequently distinguished as the "Cambrian Mountains," though "Welsh Hills" is the more popular designation. The highest summit is Snowdon (3,571 feet), close to the Menai Strait. A natural depression at the head of the Severn divides North from South Wales, and the hills of the latter are particularly distinguished by their barrenness, their highest range being known as Black Mountains (Brecknock Beacon, 2,910 feet), from the color of the heather which covers them. The Welsh Hills, toward the E., merge into the table-lands of Salop, Hereford, and Gloucester, where several outlying hill-ranges rise, among which may be mentioned the Malvern Hills (1,395 feet), the Clee Hills (1,805 feet), and the isolated Wrekin (1,342 feet) in the center of Shropshire. Several of the valleys of this Cambrian region are distinguished for their loveliness, and among these that of the Wye in the S. and of the upper Dee in the N. carry off the palm for beauty.

HYDROGRAPHY.—The rivers of England are mere brooks if compared with those of America, but as they all carry an abundant supply of water throughout the year, and many of them are navigable for a considerable distance of their course, they are, nevertheless, of considerable importance to commerce and industry. They belong to four oceanic drainage basins, viz., those of the German Ocean (Tyne, Humber, Ouse and Trent), the English Channel, the Bristol Channel (Severn), and the Irish Sea. The most considerable of these rivers are the Humber (catchment basin 9,293 sq. miles, length 204 miles), Severn (8,119 sq. miles, 186 miles), Thames (5,935 sq. miles, 215 miles), the Great Ouse (2,766 sq. miles, 156 miles), and the Mersey (1,722 sq. miles, 85 miles).

The Mersey rises on the confines of Cheshire and Derbyshire, and forms a wide estuary at its mouth, on which is situated Liverpool, the first shipping-port of Europe. Its tributary, the Irwell, is navigable for barges as far as Manchester, and canals connect it with the principal rivers of the rest of England. The Severn rises on the slope of Plynlimmon in Wales, and becomes navigable at Welshpool, 170 miles above its mouth. It traverses the fertile plain of Shrewsbury and the vale of Gloucester, and enters the Bristol Channel below the town of that name. The tides at its mouth are of tremendous height (60–70 feet), and the country is protected against them by embankments. Its most important tributaries are the Wye and the Avon. Bristol is situated on the latter.

The Thames rises at Thameshead, 376 feet above the level of the sea, and enters the German Ocean at the Nore Light, between Shoeburyness and Sheerness. At its mouth it is 5 miles wide, at London bridge, 46 miles above it, 692 feet, and as far as the latter it is navigable for vessels of 300 tons. Its most important tributary is the Medway, which forms an excellent harbor. The Ouse rises in Northamptonshire, and is navigable from Retford, 46 miles above its mouth. It enters the Wash at King's Lynn. The Humber, properly speaking, is an arm of the sea, into which the Trent and Yorkshire Ouse pour their waters, and extends 37 miles inland. Hull, an important commercial town, is situated on its north coast at the mouth of the small river Hull. The Trent rises in the moorlands of Staffordshire, intersects an exceedingly fertile district, and becomes navigable at Burton-upon-Trent. Small sea-going vessels can ascend it as high up as Gainsborough. The Ouse descends from the Pennine chain, and is navigable for small craft as far as York. Still higher up the coast are the Tees and the

* The name "Albion" which is bestowed sometimes upon Great Britain is not derived from *albus*, white, but from the Gaelic *albainn*, which means "mountain island."


ENGLAND
AND
WALES
English Miles
10 20 40 60 80
B C D E F G H I J K L M
72° 73° 74° Longitude East 75° from Washington 76° 77° 78°
56° 55° 54°
1 2 3 4 5 6 7 8
SCOTLAND
IRELAND
North Channel
IRISH SEA
NORTH SEA
EDINBURGH
GLASGOW
Cantyre
Arran
Ayr
Dumfries
Wigton
Berwick on Tweed
Cheviot Hills
NORTHUMBERLAND
CUMBERLAND
DURHAM
WESTMORLAND
LANCASHIRE
CHESHIRE
LINCOLN
YORK
Newcastle
Tynemouth
Sunderland
Carlisle
Durham
Whitehaven
Whitby
Scarborough
York Moors
York Wolds
I. OF MAN
Douglas
Morecambe Bay
Lancaster
Kendal
Preston
Blackpool
Leeds
Bradford
Halifax
Huddersfield
Rochdale
Manchester
Liverpool
Sheffield
Hull
Lincoln
Chester
Carnarvon

ST GEORGES CHANNEL
Cardigan Bay
Carmarthen Bay
BRISTOL CHANNEL
ENGLISH CHANNEL
STRAIT OF DOVER
MONTGOMERY
RADNOR
BRECKNOCK
CARMARTHEN
PEMBROKE
GLAMORGAN
MONMOUTH
HEREFORD
WORCESTER
STAFFORD
LEICESTER
NORTHAMPTON
WARWICK
OXFORD
BUCKS
BERKS
BEDFORD
HERTFORD
CAMBRIDGE
NORFOLK
SUFFOLK
ESSEX
MIDDLESEX
LONDON
SURREY
KENT
SUSSEX
WILTS
SOMERSET
DORSET
DEVON
CORNWALL
Dartmoor
New Forest
The Weald
I. of Wight
River Thames
Bristol
Cardiff
Newport
Swansea
Exeter
Plymouth
Southampton
Portsmouth
Brighton
Dover
Calais
Boulogne
Dieppe
Lands End
The Lizard
Lundy I.
Portland Bill
Longitude West 1° from Greenwich
Longitude East
52°
51°
50°
B C D E F G H I J K L M
9 10 11 12 13 14 15 16

Tyne, neither of great size, but of some importance on account of the emporia which lie at their mouths.

England may boast of numerous lakes in the Cumbrian Mountains, the so-called "Lake District," but, though they are distinguished for picturesque beauty, the largest among them, Windermere, covers an area of only 4 sq. miles. Wales is even poorer in lakes.

Tepid and mineral springs are numerous, but few of them have a great reputation, and none can vie in popularity with the famous health resorts of continental Europe. Among the springs may be mentioned Bath, Buxton, and Matlock. Noted for their mineral springs are Harrogate, Malvern, Cheltenham, Scarborough, Tunbridge Wells, Epsom, Leamington, and Droitwich.

Climate.—For the general features of the climate, see Great Britain. The following table exhibits the climatological features of a few towns:

TOWNS.	Latitude.	MEAN TEMPERATURE.			Rain, inches.
		January.	July.	Year.	
Carlisle	54° 54′	36°	58°	47°	31
Liverpool	53 25	41	62	50	35
Bristol	51 27	36	67	51	24
Penzance	50 71	43	62	52	46
London	51 30	38	64	51	25
Hull	53 45	39	61	50	18
Birmingham	52 55	37	62	49	32

For remarks on the *Geology*, *Flora*, and *Fauna*, see Great Britain.

Population.—The population of England and Wales has steadily increased since 1800, notwithstanding emigration, which annually carries away thousands into other parts of the world. The population, which in 1801 numbered 8,892,536 souls, had grown to 29,001,018 by the beginning of 1891, an increase amounting to 226 per cent. (1871–81, 14·5 per cent.; 1881–91, 11·6 per cent.). This increase affected different parts of the country variously. It was most rapid in the great centers of commerce and industry, less so in the rural parts, and of late the towns have grown at an ever-increasing rate at the expense of the country. Between 1881–91 the town population increased 15·3 per cent., the rural population only 3·4 per cent. In fourteen entire counties (nine of them in Wales) the population actually decreased. The manner in which emigration and immigration have influenced the increase of the population may be judged from the following figures: The number of persons of English origin who emigrated between 1871 and 1891 was 2,545,333; the population during these twenty years increased 6,288,752 souls, while the births exceeded the deaths by 7,071,373. Hence the loss due to emigration, and not compensated by the return of emigrants, or direct immigration, amounted to 782,641 souls. That immigration into England and Wales is a factor of some importance is clearly shown by the classification of the inhabitants according to their place of birth. In 1881 95·69 per cent. were natives of England and Wales; 2·17 per cent. (562,374) of Ireland; 0.98 per cent. (253,528) of Scotland; 0·47 per cent. (123,715) of British colonies; and 0·67 per cent. (174,372) of foreign parts. See Great Britain.

The following table gives the population of England and Wales according to the advance bulletins of the census of March 31, 1901:

ADMINISTRATIVE COUNTIES.	Pop. in 1901.	ADMINISTRATIVE COUNTIES.	Pop. in 1901.
England.			
Bedfordshire	171,699	Middlesex	792,225
Berkshire	180,366	Monmouthshire	230,792
Buckinghamshire	196,843	Norfolk	313,438
Cambridgeshire	185,128	Northamptonshire	248,585
Cheshire	601.042	Northumberland	387,728
Cornwall	322,857	Nottinghamshire	274,683
Cumberland	266,504	Oxfordshire	137,118
Derbyshire	601,577	Rutland	19,708
Devonshire	436,913	Shropshire	239,297
Dorsetshire	202,093	Somerset	385,059
Durham	833,310	Staffordshire	879,625
Essex	816,524	Suffolk	306,688
Gloucestershire	331,515	Surrey	519,522
Hampshire	459,508	Sussex	413,231
Herefordshire	114,150	Warwickshire	347,693
Hertfordshire	258,044	Westmoreland	64,411
Huntingdonshire	54,127	Wiltshire	271,372
Kent	936,003	Worcestershire	358,357
Lancashire	1,827,330	Yorkshire	1,892,415
Leicestershire	225,895		
Lincolnshire	388.037	Totals of England	21,930,846
London	4,536,034		

TABLE OF POPULATION—CONTINUED.

ADMINISTRATIVE COUNTIES.	Pop. in 1901.	ADMINISTRATIVE COUNTIES.	Pop. in 1901.
Wales.			
Anglesey	50,475	Montgomery	54,892
Brecknock	54,211	Pembroke	87,856
Cardigan	61,068	Radnor	23,263
Carmarthen	135,320		
Carnarvon	125,654	Totals of Wales	1,455,680
Denbigh	131,588	The 67 county boroughs	9,139,190
Flint	81,487		
Glamorgan	601,080	Totals of England and Wales	32,525,716
Merioneth	48.786		

Agriculture.—The cultivation of the soil is no longer the remunerative industry which it was before competition with North America became keen, but it would be wrong to assume that land has actually gone out of cultivation. The English farmer has perhaps been rather slow to adapt himself to the changed circumstances, but he has now learned by experience that cattle-farming will pay better than corn-growing. Hence much land has been laid down with grass. In 1872 40 per cent. of the total area consisted of arable land; in 1892 only 35 per cent. On the other hand, the permanent pastures had grown from 31 to 41 per cent. In 1885 there were 475,140 "holdings" (farmsteads), inclusive of 136,425 under 5 acres each. Efforts have been made to encourage market gardening, spade husbandry, and poultry-breeding, by enabling laborers and others to obtain small allotments; but although 455,000 of these allotments (all of less than 1 acre) had been granted in 1891, their influence upon the agricultural position of the country appears to have been very trifling. Wheat is principally grown in the southeast; oats succeed best in the north; Cheshire and Lancashire are noted for potatoes; fruit-trees are most numerous in the west and southwest; and large quantities of grapes are produced in hothouses.

The live stock consisted in 1900 of 491,143 horses, used in agriculture or for breeding; 4,608,443 cattle; 4,386,697 sheep; and 1,268,474 pigs. The counties of Cheshire, Gloucester, and Leicester (Stilton) are noted for their cheese; Devonshire for its cream; Cambridge, Suffolk, York, Somerset, and Oxford, besides the counties already named, for their butter.

Fisheries.—The fisheries employed (1899) 108,513 persons, and 430,240 tons of seafish, valued at £6,342,022, were landed, besides 50,000,000 oysters, and 532,492 cwt. of lobsters and other shellfish. See Fisheries.

For information on *Mines*, *Manufactures*, and *Commerce*, see Great Britain.

Religion, and Provisions for its Support.—England still retains an Established (state) Church, of which the sovereign is the supreme governor (see the next article). Its bishops are appointed by the responsible ministers of the crown, and they have a seat in the House of Lords; its revenues are largely derived from tithes; its priests are introduced to their livings by patrons, and not elected by the congregations. There are 2 archbishops—namely, those of Canterbury and York—33 bishops, and 14,684 ecclesiastical parishes. There is a clerical parliament (convocation), as also a house of "laymen," but the influence of these bodies upon the government of the Church is next to nothing. The annual income of the Church from *all* sources is estimated at £7,250,000. No civil disabilities whatever attach to non-adherence to the Church. Persons can be married by a civil registrar; they may decline to be sworn in a court of justice, if they declare that an oath has no binding force upon them; and they no longer pay church-rates. The disestablishment of the Church is merely a question of time. Among Dissenting bodies the leading ones are the Methodists, the Independents or Congregationalists, the Baptists, and the Presbyterians, among whom may be included those English Presbyterians who now usually call themselves Unitarians. The Roman Catholics, who have gained strength through Irish immigration, are organized under an archbishop (Westminster), 14 bishops, and 2,837 priests (1871, 1,620).

No religious census has ever been taken in England, but there can be no doubt that the members of the Church of England outnumber the adherents of all other religious communions. The number of Roman Catholics does not probably exceed 1,250,000, while the number of Jews falls short of 100,000. The number of secularists, positivists, and agnostics is ever on the increase, and that not only among the upper classes.

Education.—Elementary education has made considerable strides in advance since an act passed in 1870 compelled each locality to provide school accommodation for all children between the ages of five and thirteen, and provided for the election of school boards in all those districts where this accommodation had not been provided by voluntary agencies. These public elementary schools are annually inspected by Government officials, and they receive grants in aid out of the public treasury, in addition to what they may raise by rates or receive from voluntary contributions. All schools supported from the rates are undenominational, and no dogmatic teaching is permitted. In 1899 there existed 20,064 elementary schools: viz., 5,632 under school boards; 11,824 connected with the Church of England; 1,037 Roman Catholic; 1,571 others. There were present at the inspection 5,654,092 children; but the average attendance was only 4,636,938. See Common Schools.

Middle-class education is mainly left to private enterprise. There are 3 universities (Oxford, Cambridge, and Durham) and 15 colleges, with 1,162 professors and 17,443 students, besides 4 university colleges for ladies, medical schools attached to the hospitals of most of the large towns, and a large number of technical and art schools. London university is merely a board of examiners.

Local Government.—By the Local Government Act of 1888 England was divided into 122 administrative counties, inclusive of 62 county boroughs, all of which have over 50,000 inhabitants. The crown is represented in each county by a lord-lieutenant, a sheriff, and justices of the peace. The duties of the lord-lieutenant are at the present time merely nominal, while the justices of the peace, who not long ago carried on nearly the whole of the local administration outside the municipalities, now exercise hardly any but judicial functions. Each county has its county council, consisting of a chairman (mayor), aldermen, and councilors. The councilors are elected by the ratepayers for three years; the aldermen by the councilors (not necessarily out of their own number). Smaller towns still retain a large measure of administrative independence. The whole of the administration of the poor laws is intrusted to guardians elected by the ratepayers, while elected schoolboards administer the public schools. Women have votes in the election of these local authorities, and can themselves be elected guardians or members of school boards, but not county councilors. There exist, in addition to the above, rural sanitary authorities, highway boards, drainage and embankment authorities, harbor and pilotage authorities, etc. The total receipts of the local authorities (1897-98) amounted to £83,876,900. Out of the expenditure, £10,828,276 was for paupers, £10,081,770 for schools. The local debt at the close of 1898 amounted to £262,017,152.

Administration of Justice.—The judicial systems of England and of the U. S. are very similar. A distinction is made between common and statute law, and only occasionally, in admiralty and ecclesiastical cases, is recourse had to Roman or canon law. Four ancient corporations or "inns" enjoy the privilege of calling persons to the bar. King's counsel, as well as judges, are appointed by the Lord Chancellor, who likewise appoints many of the inferior judges, and thus exercises a considerable amount of political patronage. The Supreme Court of Judicature, with twenty-nine judges, none of whom is paid less than £5,000 a year, includes a court of appeal, a chancery division, a king's bench division, a court of probate, divorce and admiralty cases, and a court of arches (for ecclesiastical cases). Thrice a year these judges go on circuit, and hold assizes in the principal towns. A central criminal court exists for the especial benefit of the metropolis, and is presided over by the recorder and the common sergeant of the city of London. The justices of the peace (magistrates) are appointed by the Lord Chancellor, and receive no salary. They hold petty and quarter sessions; these latter are frequently presided over by a paid recorder. In London there are sixteen police courts. The seventy county courts, whose judges are paid from £1,500 to £1,800 a year, exercise only civil jurisdiction, while the coroner with his jury holds inquests into the cause of all violent or suspicious deaths. See Courts.

The police force of England numbers 43,450 men (of whom about one-half are in London). Of 11,044 persons committed for trial in 1899, 8,749 were found guilty.

History.—England first became known to the Western world through the Phœnicians and Massilians, who traded with it for tin; but its real history does not begin until the establishment of the Roman rule by Cæsar in 55 b. c. The rule of the Romans, who called the present island of Great Britain *Britannia*, lasted till the beginning of the fifth century, when they withdrew. (See Britannia.) In consequence of the inroads of the Picts and Scots from the north, and the quarrels of the British chiefs among themselves, the country appears to have soon become a prey to complete anarchy. A British Prince of Kent, Vortigern (Gwrtheyrn), is said to have been the first to secure the aid of two Saxon chiefs, commonly called Hengist and Horsa, in his struggles against the northern invaders. The statements as to the first appearance of the Saxons in England are conflicting and untrustworthy, and even the names of their leaders are considered fabulous. Certain it is that in the course of about 130 years the Saxons, Jutes, and Angles completed the conquest of the greater part of England, establishing three Saxon kingdoms (Sussex, Wessex, and Essex), one Jutish (Kent), and four Anglian (Bernicia, Deira, East Anglia, and Mercia). The British maintained for a somewhat longer period five states (Strath-Clyde, Cumbria, North and South Wales, and Cornwall). Egbert, King of Wessex, is commonly believed to have become the first King of all England. During his reign began the invasions of the Danes about 830, who for a period of twenty-four years (1017–42) became masters of the kingdom. In 1042 the crown again devolved on an Anglo-Saxon prince, Edward the Confessor, but his authority was little more than nominal, six powerful earls, Danes and English, dividing the country between them.

The Norman Conquest.—Edward the Confessor died childless in 1066, and Harold, the son of Goodwin, was elected by the nobles to the throne; but in the decisive battle of Hastings (Oct. 14, 1066) against another claimant to the throne, William, Duke of Normandy, he was defeated and killed. With the reign of William, surnamed "the Conqueror," a new era of English history begins. The lands were divided among 600 tenants *in capite*, all followers of the Conqueror as feudal lords, and thus on the solid basis of extensive landed estates the firm foundation was laid of a powerful aristocracy, which amid the social revolutions of centuries has more successfully defended its ascendency than that of any other country of Europe. The population of England at this time appears to have been at most 2,000,000, and about 100 boroughs were governed by municipal customs or under the protection of the kings, nobles, or prelates, from whom in after times they purchased their franchises. In the course of time the distinction between the Norman conquerors and the conquered Saxons passed away, and from their union arose the English people as it now exists. The Norman line gave to England only three kings—William I. and his two sons, William II. and Henry I. The death of the latter in 1135 was followed by a war of succession between Stephen of Blois, his nephew, and his only daughter, Matilda, who was married to Geoffrey Plantagenet. In 1154 the son of Matilda, Henry II., was generally recognized as King of England. He was the founder of the house of Plantagenet, which in direct line ruled in England until 1485. Henry possessed, besides England, the provinces of Anjou, Touraine, and Maine in France, to which he added Guienne and Poitou by marriage and Brittany by conquest. He conquered Ireland in 1171, and by the Constitutions of Clarendon in 1164 curtailed the privileges of the Church, but was forced, in consequence of the assassination of Archbishop Becket, to make his peace with the Church. He was in 1189 succeeded by his eldest son, Richard I. (Cœur de Lion), who distinguished himself in the crusades, but could not prevent the nobility from increasing their power at the expense of the crown. The reign of his younger brother, John (Lackland, 1199–1216), is one of the most inglorious in the English annals. He lost nearly all the possessions of the English sovereigns in France, and in 1213 consented to hold the English crown as a gift from Rome. His weakness, however, had some good results for the people of England.

The Beginnings of Constitutional Liberty and Representative Government.—The separation of the Normans of England from those of France hastened the consolidation of the English nation; and when involved in disputes with the pope, John had to conciliate the barons, who were backed by the people, by the concession of the celebrated Great Charter (*Magna Charta*), signed at Runnymede in 1215. The charter secured to the English people, in advance of any other people of Europe, two great rights—that no man should suffer arbitrary imprisonment, and that no tax should be imposed without the consent of the council of the nation.

When John showed an unwillingness to carry out some of his promises, the barons called Louis of France (son of the king, Philip Augustus) to their aid, who conquered a large portion of the country, but was compelled, soon after the death of John (Oct. 17, 1216), to make peace and renounce the project of annexing England to France. But while the national pride of the English people successfully prevented its subjection to France, anarchy rapidly increased during the reign of John's son, Henry III. (1216–72). As Henry at the death of his father was only a boy of nine years, the government was carried on first by the Earl of Pembroke, and after his death by Hubert de Burgh and the Bishop of Winchester, neither of whom was able to check the demands of the nobility for greater power. When Henry assumed the government himself, an open war soon broke out with the barons, who extorted from the king an enlargement of the Great Charter, and in 1264, at the battle of Lewes, took him and his eldest son, Edward, captives. The next year the first English Parliament was convened by the leader of the rebels, Simon de Montfort, Earl of Leicester; but soon Prince Edward, who had been set free, broke the power of the barons in the battle of Evesham (Aug. 4, 1265), in which de Montfort fell, and restored the authority of the king. Henry deemed it, however, best to assume a conciliatory policy, and in particular to confirm the Great Charter. Edward I. (1272–1307) had sufficient energy and statesmanship to put an end to the confusion into which the country in the latter years of his father's reign seemed to relapse, and considerably promoted the consolidation of the kingdom.

Conquest of Wales and War with Scotland.—In 1282 Edward conquered the last Prince of Wales, and united this country, which thus far had been semi-independent, forever with England, conferring on his eldest son the title of Prince of Wales, which has ever since been borne by the eldest son of the English sovereign. He obtained a decisive victory over Scotland in the battle of Dunbar (1296), defeated William Wallace at Falkirk (1298), led a third large army into Scotland (1303), but died on the eve of a fourth invasion, "in sight of that country which he had devoted to destruction." His barbarous warfare first aroused feelings of hostility between the Scotch and English, which subsequently did much mischief. For the development of the English constitution his reign was of the greatest importance, as the council of the realm assumed a form resembling that of the modern Parliament by the separation of the greater barons from the tenants in chief, the latter ceasing to be summoned to Parliament, and being present only through their representatives. The first sitting of the Commons in a separate chamber took place in 1296, and in the following year (1297) the famous statute was passed that no manner of tax should be imposed without the common consent of the bishops, barons, and burgesses of the realm. Edward II. (1307–27) lost the footing which his father had gained in Scotland, was defeated by Robert Bruce in the battle of Bannockburn 1314, and was finally murdered in prison.

The Period of the Hundred Years' War.—The reign of Edward III. (1327–77), is regarded as one of the most brilliant periods of English history. His claim to the throne of France involved him in the HUNDRED YEARS' WAR (*q. v*), which, with several intervals of peace, lasted from 1337 to 1453, and which, notwithstanding the brilliant English victories of Crécy (1346) and Poitiers (1356), finally led to the surrender by the English king of all the English possessions in France except Guines and Calais. The great expenditures required by the war made the king dependent on his Parliament, which henceforth was directed by statute to be summoned annually. Another important result of the war was the entire fusion of the Normans and Saxons into the English nationality. The spirit of chivalry attained at the court of Edward its highest point of exaltation, but, on the other hand, the laboring classes made their power felt for the first time; for as their service had become more valuable in consequence of the terrible ravages of the great pestilence in 1349, they demanded and received higher wages, and a series of despotic edicts, known as the Statutes of Laborers, ordering them to work at the former wages, proved entirely inefficient. During the reign of Edward, Wycliffe began (about 1360) his attacks upon the abuses in the Church, and he was supported by Edward's fourth son, John of Gaunt, and by some of the principal nobility. As the king's eldest son, Edward, Prince of Wales, known as the "Black Prince," died one year before his father (1376), the latter was succeeded by his grandson, Richard II. (1377–99), during whose weak reign an attempt to enforce a poll-tax brought on the famous rebellion of the peasantry under Wat Tyler, which was suppressed with much bloodshed. Richard was dethroned by his cousin Henry, Duke of Lancaster, who ascended the throne as Henry IV. (1399–1413). His reign, which was greatly disturbed by rebellions and conspiracies, is remarkable for two events in the history of the English constitution—the fixing by statute of the parliamentary right of election for counties in all freeholders, and the recognition of the two houses as bodies possessing distinct privileges, not to be interfered with by each other. The religious reformation of Wycliffe found in Henry a determined opponent, the act for the punishment of heretics under which so many atrocities were committed for nearly two hundred years being passed during his reign (1401). His son, Henry V. (1413–22), put down the religious movement of the Lollards with a strong hand, and renewed the claims of his ancestors to France. The new war between the two countries was favorable to England; Henry landed with 30,000 men in Normandy, won the battle of Agincourt Oct. 25, 1415, and on his death a large portion of France recognized, with England, his son, Henry VI. (1422–61), then only a boy of nine months, as king. After many campaigns the French were, however, ultimately successful, the exploits of Joan of Arc, Dunois, and other French leaders putting forever an end to the English attempts to conquer France.

War of the Roses.—Soon after, the war known as the war of the Red and White Roses (or of the Lancastrians and Yorkists) began. Richard, Duke of York, a descendant of the Duke of Clarence, third son of Edward III., claimed a title to the throne preferable to that of King Henry, on the ground that the latter was only a descendant of the fourth son of Edward III., and that the pretensions of the king's grandfather, Henry IV., to be descendant from Edward, Earl of Lancaster, according to popular tradition the eldest son of Henry III., and excluded from the succession on account of deformity, were apocryphal. Richard, Duke of York, was taken prisoner in the battle of Wakefield, Dec. 30, 1460, and executed, leaving his claims to his eldest son, Edward, the Earl of March, a youth of nineteen, who was proclaimed king as Edward IV. in 1461, and maintained himself until his death (1483), with a short interruption (1470–71), when the rebellion of the Earl of Warwick, the "king-maker," formerly the most prominent among his supporters, compelled him to flee to Holland, and restored for the time Henry VI. The son of Edward (Edward V.), a minor, was after a reign of only thirteen days dethroned by his uncle, the Duke of Gloucester, placed in confinement, and soon disappeared. The usurper made himself king under the name of Richard III. (1483–85), but soon a coalition of disaffected Yorkists and of the Lancastrians was formed against him, at the head of whom was Henry Tudor, Earl of Richmond, who through his mother descended from the house of Lancaster, and to satisfy the Yorkists was to marry Elizabeth, the eldest daughter of Edward IV. In the decisive battle of Bosworth Field, in 1485, Richard lost his life, and Tudor ascended the throne as Henry VII. With him a new era begins in English history. The first years of Henry (1485–1509) were greatly disturbed by pretenders to the throne, who, personating the head of the house of York, claimed to be the legitimate heirs to the crown. But the chief feature of his reign is the large increase of the royal power at the expense of the high nobility and the Parliament. Many of the principal nobles having perished in the wars of the Roses, Henry succeeded in enforcing against the barons the laws forbidding them to give badges and liveries and to employ retainers. The change thus produced in the relation of the nobility to royalty became still greater from the fact that the former began to value money payments from their tenants and dependents higher than personal services, while the lower classes of the people began to understand that hereafter they had to support themselves and to respect the laws, instead of looking to the nobility for support and for impunity in case they had committed lawless acts.

The Reformation.—The great event in the reign of his son, Henry VIII. (1509–47), was the separation of the Church of England from Rome. Henry was a violent opponent of Luther and the German Reformation, but when the pope refused to grant him a divorce from his wife, Catharine of Aragon, he renounced his communion with the pope and assumed the title of the Head of the Church, and alike persecuted Catholics who refused to recognize his "supremacy" and Protestants. (See ENGLAND, CHURCH OF.) His only son, Edward VI. (1547–53), succeeded at the age of nine years, and the country thenceforth was governed by a council of regency favorable to the Reformation, which now advanced from questions of government to questions of doctrine. The Duke of Northumberland, who had caused one of his sons to marry Lady Jane Grey, great-granddaughter of Henry VII., induced Edward to bequeath the crown to his daughter-in-law; but the reign of Lady Jane lasted only ten days when "bloody" Mary (1553–58), the daughter of Henry VIII. and his first wife, Catharine of Aragon, ascended the throne. Mary was a devout Catholic, who obtained the consent of her Parliament to repeal (1553) the legislation of Edward VI., and that (1555) of Henry VIII., thus re-establishing the papal authority. When the chiefs of the Protestant party opposed the counter-reformation 290 of them suffered at the stake, including Cranmer, Ridley, and Latimer. Her marriage with Philip II. of Spain did not, however, save to the Catholic Church its ascendency in England, for Mary died in 1558 without issue, and, on the other hand, it cost England the last possession in France, Calais, which was taken by the Duke of Guise. Mary was succeeded by her half-sister, Elizabeth (1558–1603), the daughter of Henry VIII. by his second wife, Anne Boleyn. She was strongly opposed to the supremacy of the pope, by whom she had been declared to be a bastard. Parliament in 1559 restored the royal supremacy of the Church, which by the adjustment of the Prayer-book and the Thirty-nine Articles, substantially received the form in which it still exists. The power of the Roman Catholics in England was completely broken; and when most of them embraced the cause of Mary, Queen of Scotland, who, on seeking an asylum in England, had been imprisoned, Elizabeth ordered Mary to be executed. Abroad she aided the Protestants of France and the Netherlands, and the crushing defeat of the Spaniards, whose armada was destroyed in 1588, elevated England to a higher position among the countries of Europe than she ever had held before. Ireland was reduced to a state of entire submission, and the commerce and naval power of England received a wonderful impulse by the establishment of commercial intercourse with India (East India Company chartered 1600). Elizabeth was the last sovereign of the house of Tudor; she was succeeded by James VI., the son of the unfortunate Mary. Thus England, Scotland, and Ireland became united under one sovereign, and although the legislative union with Scotland was not consummated until 1707, and that of Ireland not until 1800, the three countries were in fact one empire.

The Struggle between Parliamentary Privilege and Royal Prerogative.—James VI.—or, as he was called after his succession to the throne of England, James I.—was proclaimed Mar 24, 1603, crowned July 25, assumed the title of King of "Great Britain, France, and Ireland" Oct. 24, and reigned till Mar. 27, 1625. He had received a good education, and showed great interest for science and literature, but he was pedantic and inconsistent. After the discovery of the Gunpowder Plot (Nov. 5, 1605) he banished the Jesuits and seminary priests from England, and afterward wrote several treatises himself in defense of pure Protestantism. But he failed to give his son-in-law, the elector palatine, from whom descends the house of Hanover, the aid he had promised him; and one of the principal reasons why he disappointed his Protestant allies in Germany was his eagerness to marry his son to a Roman Catholic princess of Spain. In his time the translation of the Bible into English and the colonization of Virginia and New England took place. Meanwhile the political tendencies which at this time were carried out with such great success in France by Richelieu—namely, the consolidation of the royal power and the concentration of all authority in the crown—also began to show themselves in England. During the time of James I. there was much talk about "the king by God's grace," and hardly had his son, Charles I. (1625–49), ascended the throne when the conflict actually began between the king and the Parliament. He had declared that he would not be a Venetian doge, and his two first Parliaments he dissolved. But the third, which sat in 1628, passed the so-called Petition of Right, in which the constitutional rights of an Englishman are clearly defined, and the king was compelled to give his consent to the petition. After this event, however, he convoked no Parliament for eleven years, but ruled as arbitrarily as if there had never been a Parliament or a constitution. Justice was administered by the Star Chamber, money was levied by proclamations, and the Puritans and other Nonconformists were cruelly persecuted. Charles wished to introduce the liturgy in Scotland (1637), but the Scottish people rose in arms, subscribed the National Covenant, invaded England, and defeated the royal troops at Newburn-on-Tyne. In Nov., 1640, the Long Parliament assembled, and began business by impeaching Strafford and Laud. The Star Chamber was broken up, the dispensing power abolished; but when the Parliament went further and demanded that the king should give up his right to dissolve Parliament, and even resign the supreme military command, open war broke out between the king and the Parliament.

The Civil War.—In the beginning the king was successful, gaining several small victories; but in 1644 he was defeated at Marston Moor, and in the following year he was so thoroughly beaten at Naseby that he had to flee for his life, and finally gave himself up to the Scottish army, which gave him into the hands of the English Parliament. A high court was appointed, before which King Charles was tried. He was convicted, and beheaded Jan. 30, 1649. Oliver Cromwell, who commanded the right wing in the battle of Naseby and contributed much to the victory, controlled the army, which belonged to the party of the Independents; and after the so-called Pride's Purge, in Dec., 1648, when forty-one Presbyterian members were driven out of the Parliament, he also controlled that assembly. In 1649 he went to Ireland as lord-lieutenant, and put down the royalist rebellion there with extreme severity. In 1650 he was appointed commander-in-chief against the Scottish rising in favor of Charles II., and subdued the rebellion after the battles of Dunbar and Worcester. He was now the most powerful man in the kingdom, and in 1653 he assumed the title of Lord Protector of the Commonwealth, and governed as a monarch till his death, Sept. 3, 1658.

The Restoration.—Cromwell was succeeded by his son, but almost immediately after his death a strong royalist reaction set in, and in 1660 Charles II. returned to England and was hailed with great enthusiasm. His reign (1660–85) was one of the most shameful periods in English history. The court was dissipated and licentious, and moral contamination spread from it into the upper strata of society. The Parliament, which was very subservient at first and afterward only feebly contending against the evil, was broken up into factions and corrupted by bribery. With respect to a foreign policy, the king and the country as well became subservient to Louis XIV. of France. The two wars with Holland (1665–67 and 1672–74), which brought the English arms very little glory, were carried on in the French interest. The king in 1675 received 500,000 crowns from Louis in order to prorogue Parliament, and for several years he also received an annual pension in reward of his subserviency to the French policy. As base was his internal policy. He had given the most binding promises of amnesty and loyalty. Nevertheless, in 1662 the Presbyterian divines were ejected from their livings. This act, however, did not cause any great excitement. Indeed, Parliament itself voted that the bodies of Cromwell, Bradshaw, and Ireton should be disinterred and hanged upon the gibbet of Tyburn. But when in the same year he issued his declaration of indulgence to the Roman Catholics, people became suspicious; and when his brother, the Duke of York, heir-apparent to the crown, openly professed the Roman Catholic faith, a bill for his exclusion from the succession was brought into Parliament and passed by the House of Commons. It was rejected, however, by the House of Lords, and on the death of Charles II., James II. succeeded (1685–88).

The Revolution of 1688.—It was evidently James's intention to overthrow the constitutional system of England and restore the Roman Catholic Church. For the accomplishment of the first purpose he meant to create a large standing army, and, in spite of the great difficulties he had to encounter on this point, he partly succeeded. For the restoration of the Roman Catholic Church he first allied himself with the Episcopalians, afterward with the Dissenters. But he was much less successful on this point, and when in 1688 he issued a declaration of indulgence to the Roman Catholics, and ordered it read in all the churches, the crisis came. The Archbishop of Canterbury and six bishops petitioned the king against the order, but were sent to the Tower and tried on the charge of libel. Another event of decisive importance took place just at the same time. James II. had hitherto had no son, and it was hoped that on his death his Protestant daughter Mary, married to William of Orange, would succeed to the throne. But on

June 10, 1688, Queen Mary gave birth to a son, afterward known as the Pretender. People generally considered this child spurious, and on June 30 an invitation to invade England was signed by the Earls of Shrewsbury, Devonshire, and Danby, Lord Lumley, Henry Sidney, Edward Russell, and Henry Compton, and sent to William and Mary. They landed at Torbay (Nov. 5) with an army of 15,000 men, and as James II. saw himself deserted immediately almost by all, even by his own daughter, Anne, he fled to France. In Feb., 1689, a convention of the estates of the realm of England formally established William and Mary on the English throne, and the risings which took place in Scotland and Ireland in favor of the fugitive James II. were successfully subdued—in the former country by Sir John Dalrymple after the massacre of the Macdonalds in 1692, and in the latter by William himself in the battle of the Boyne July 1, 1690, and by Ginkel in 1691.

The War of the Spanish Succession.—Mary died Dec. 28, 1694, and William now reigned alone. In his foreign policy he was so far successful that he actually checked the progress of Louis XIV., and the result of his internal government was the firm establishment of the English constitution. By an act of settlement adopted by Parliament in 1701 the house of Stuart was formally excluded from the throne of England, which, after the death of William and his sister-in-law, Anne, was settled on the house of Hanover. After the death of James II., however, his son, the Pretender, was recognized by Louis XIV. as King of England, and this, in connection with Louis's breach of a newly concluded treaty concerning the Spanish succession, caused William to prepare for war. He died Feb. 21, 1702. His policy, however, was continued by his successor, Anne (1702–14), and led to brilliant results. The queen herself was weak both in intellect and character, but the splendid victories of Marlborough annihilated the ambitious plans of Louis XIV., and led to the conquest of Gibraltar. William had not always been successful in the field, and he proved himself greater in the council-chamber than on the battle-ground; but he knew that an army is not only a useless, but even a dangerous, instrument when not in perfect order; and the army which was placed under the command of Marlborough was probably the best organized and best disciplined body of troops then existing. The result answered his expectations. The first part of the war, from the capture of Liège (Oct. 23, 1702) to the battle of Blenheim (Aug. 13, 1704), was very brilliant; and when, in spite of an unbroken series of victories, from the battle of Tirlemont (July 18, 1705) to the battle of Malplaquet (Sept. 11, 1709), the war still dragged on, this was probably due to underhand intrigues of various sorts. In literary respects the reign of Anne was also a remarkable period, and has been called, not altogether without reason, the Augustan age of English literature, Addison, Pope, Steele, and Swift forming its most conspicuous ornaments. May 1, 1707, the complete union of England and Scotland was accomplished. For the further history of the two countries, see GREAT BRITAIN.

CHRONOLOGICAL TABLE OF THE SOVEREIGNS OF ENGLAND.

Saxon House of Cerdic.—Egbert, first King of all England, 827–36; Ethelwulf, 839–58; Ethelbald, 858–60; Ethelbert, 858–66; †Ethelred, 866–71; Alfred the Great, 871–901; Edward the Elder, 901–25; Athelstan, 925–40; Edmund, 940–46; Edred, 946–55; Edwy, 955–58; Edgar, 958–75; Edward the Martyr, 975–79; Ethelred II., the Unready, 978–1016; Edmund Ironside, 1016.

Danes.—Canute, 1017–35; Harold I., 1035–40; Hardicanute, 1040–42.

House of Cerdic.—Edward the Confessor, 1042–66; †Harold II., 1066.

The House of Normandy.—William I., the Conqueror, 1066–87; ‡William II., Rufus, 1087–1100; Henry I., Beauclerc, 1100–35; Stephen of Blois, 1135–54.

The House of Plantagenet.—Henry II., 1154–89; †Richard I., Cœur de Lion, 1189–99; John Lackland, 1199–1216; Henry III., 1216–72; Edward I., 1272–1307; ‡Edward II., 1307–27; Edward III., 1327–77; ‡Richard II., 1377–99 (deposed).

The House of Lancaster.—Henry IV., 1399–1413; Henry V., 1413–22; ‡Henry VI., 1422–61 (deposed and executed).

The House of York.—Edward IV., 1461–83; ‡Edward V., 1483; †Richard III., 1483–85.

The House of Tudor.—Henry VII., 1485–1509; Henry VIII., 1509–47; Edward VI., 1547–53; Mary I., the Bloody, 1553–58; Elizabeth, 1558–1603.

The House of Stuart.—James I. (VI. of Scotland), 1603–25; Charles I., 1625–49.

Commonwealth, 1649–59 (see CROMWELL).

The House of Stuart Restored.—Charles II., 1660–85; James II., 1685–88 (expelled); William III. of Orange and Mary II. (d. 1694), 1689–1702; Anne of Denmark, 1702–14.

The House of Hanover.—George I., 1714–27; George II., 1727–60; George III., 1760–1820; George IV. (regent in 1811), 1820–30; William IV., 1830–37; Victoria, 1837.

E. G. RAVENSTEIN.

† Killed in battle. ‡ Murdered or executed.

England, Church of: that portion of the Christian Church which has existed in England since the time of St. Augustine (A. D. 597), the early Church in England being known as the British Church. The title Church of England is also sometimes given to the English Church with reference only to the period since the Reformation, but not with accuracy, since the Church of England, like the other national churches of Europe, is, both in law and fact, a continuous body, and this continuity is recognized by the law of the land, by the acts of Parliament, and by the undisputed succession of bishops in their sees from the time these sees were founded. Christianity was introduced into England, if not in the days of the apostles, at least very soon after them; and it speedily made its way even beyond the limits of the Roman settlements. The abandonment of Britain by the Romans, the invasion of the Saxons, and the consequent neglect or persecution of the native Christians, gave a serious check to the progress of the infant Church, and in the sixth century its influence was limited to the northern part of the island, whither many of the Britons had retired to escape from the invaders. The mission of Augustine, however, was strictly to the heathen Saxons. Pope Gregory the Great had contemplated undertaking this mission in person, but upon his elevation to the papal throne had been compelled to abandon his design. Augustine (or Austin), prior of St. Andrew's monastery at Rome, was selected as his substitute. After a brief delay in France, where he was consecrated bishop by Vigilius of Arles, St. Augustine arrived in Kent in the autumn of 596. His labors were crowned with great though temporary success. The conversion of the kingdom of Kent was followed by the triumph of Christianity in all the kingdoms of the heptarchy. The influence of the Italian missionaries, however, did not extend far, if at all, beyond the limits of the kingdom of Kent. The whole northern part of England was converted by British and Irish clergy, and was governed by bishops of British consecration. There was also, for many years, much jealousy between the native and foreign churchmen, but in process of time the two missions melted into one church, and although it has long been customary to date the historical beginning of the Church of England and the succession of its prelates from the foundation of the see of Canterbury by St. Augustine (A. D. 597), still its historic connection with the ancient British Church should never be forgotten, nor the apostolical succession from the early British bishops, such as Chad of Lichfield, Wilfred of Lincoln and afterward Archbishop of York, and St. David of Caerleon, founder of St. David's, Wales.

At that time there was but one Christian Church, and the doctrines of the Church of England were of course the common faith of Christendom. In considering, as will be done presently, the events of the sixteenth century in England, it should be borne in mind that the abuses which were then removed had no existence in the sixth. The primacy of the pope had not then developed into a supremacy, and, as appears from the letters which passed between Gregory the Great and St. Augustine, the authority of the former was limited to giving advice and counsel. The controversies about image-worship, which gave occasion to the Councils of Nice and Frankfort, did not reach their height until the eighth century. The mediæval teachings of purgatory and pardons were not fully developed until the twelfth, and the growth of the idea of papal supremacy was necessarily kept in check by the Eastern patriarchs until the eleventh. The final impetus was given to its growth by the separation of the Eastern and Western churches, and the general acceptance in the West of the pseudo-Isidorian decretals.

As time went on these teachings made progress in England, as they did in the rest of Western Europe. As the papal authority took the obnoxious form of claiming a right to confirm the nominations of bishops and to hear appeals, it was met with frequent and vigorous opposition—not only in England, but also in the other kingdoms of Europe. Appeals to Rome had been prohibited in England from a very early period, and a vacancy in an episcopal see was apt to lead to a protracted controversy between the pope and the reigning sovereign, neither of whom was willing to admit the pretensions of the other.

When in the reign of Henry VIII. the Church and Parliament of England resolved to put an end to appeals to Rome, and to the claims of the pontiffs to a right to confirm the nominations of bishops (which, under certain circumstances, had been stretched into a claim to nominate in the first instance), they conceived that they were merely re-asserting those ancient rights of the Church of England which, though they had been suffered to fall into disuse, had never been abandoned. This position was taken with great unanimity, and was adhered to consistently by Bishop Gardiner and the national (or, as it might now be called, the old Catholic) party in England. The king was drawn into the violent measures of the dissolution of the monasteries and the spoliation of the Church by other counselors.

The efforts of the Church of England to regain its ancient liberties were contemporaneous with, though distinct from, the continental Reformation. That event, however, was not without its influence in England, and in the reign of Edward VI. men who sympathized with Luther or Calvin, or even with the teachings of Zwingli, had gained control over the English Church and nation. Under their influence England was becoming rapidly Protestantized, and, in all likelihood, had not their career been cut short by the death of the king, the religious condition of England would have been much the same as that of Switzerland or Scotland.

The accession of Queen Mary led to a violent reaction. The Protestant school of Cranmer and Ridley was forcibly suppressed, and the national party, of which Gardiner was the leader, was compelled to change its ground. The authority of the pope was restored in more than mediæval plenitude. Attempts were made not only to revive the state of things which existed in the early part of the reign of Henry III., but actually to destroy the ancient liberties of the Church of England. It is a grave question among historians whether Edward or Mary, both acting doubtless from the most conscientious motives, would, had their reigns been prolonged, have done more serious injury to the Church.

Queen Elizabeth, on coming to the throne, found herself encompassed with difficulties. There were then three schools or parties in the English Church: first, that of Gardiner and his followers, which had changed its ground, and was now disposed to maintain the papal supremacy, with all that it involved; second, that of Parker, which went beyond the former national school in its desire to reform what it believed to be abuses; and third, the Protestants, many of whom had taken refuge in Switzerland during the reign of Mary, and these returned full of admiration of the form of religion which they found established there, and anxious to introduce it into England. The private opinions of the queen, if indeed she had any, were not distinctly known, and it was for some time doubtful to which school she would give her influence and approbation. It may seem strange to minds educated in the ideas of the nineteenth century that the religious belief of great nations should have been directed or influenced by the private opinions of their sovereigns; but in the sixteenth century, and even later, the Church formed a part of the constitution of the nations of Western Europe. There was no idea that there could be more than one religious society in a nation, and therefore no idea of toleration or religious liberty. The history of England in the sixteenth century is not different from that of other European states. If the civil authority could carry out a reformation of religion in England and Sweden, it could suppress it in France and Spain and Italy.

Thus it was the purpose of any party that might succeed in gaining the favor of the queen to become not merely dominant but exclusive. Its peculiar views were to be forced on all men. The Protestant (or, as it was soon afterward called, the Puritan) school speedily put itself out of the question by the fact that its teachings would have led to the destruction of the Church of England, and the establishment of a new form of religion upon the plan adopted at Geneva. Various circumstances tended to alienate the queen from the papal (or, as it began to be styled, the Roman Catholic) party. The haughty discourtesy with which Pope Paul IV. received the information of her accession, which she sent to him in the usual form; the assumption of the title of Queen of England by Mary of Scotland, with the great probability that France and Spain would proceed to assert the claims of the Scottish queen by force of arms; and the persistent attitude of opposition to all reforms maintained by the Marian bishops, compelled Elizabeth to put herself in the hands of the national or reforming party, of which Matthew Parker was the acknowledged leader. Like the national party in the reign of Henry VIII., this school was prepared to remove the jurisdiction which the pope had exercised within the realm of England. Like those earlier leaders, it desired to preserve the faith and discipline of the Church unaltered, but it went beyond them in proposing to remove certain abuses of teaching and practice which it conceived had led the people into superstition. These were the use of images, the invocation of the saints, the popular idea of purgatory, and the peculiar definition of the manner of the Real Presence in the blessed sacrament which is known as transubstantiation. These were doubtless developments, but, in the view of the school of thought which became dominant in England, unlawful developments of true doctrines. The Reformers thought that they could trace the progress of variation from the simpler teachings of the earlier Church, and their purpose was to carry back the Church of England, as nearly as possible, to its primitive simplicity. Whether they succeeded or not is a question which need not be now discussed; it will be sufficient to say that they proceeded to carry out their plans with promptitude and vigor. Parker was made Archbishop of Canterbury in the place of Pole, who had died almost at the same time as Queen Mary. The majority of the bishops, refusing to co-operate with him, were removed or resigned their sees, and their places were filled by men whom he could trust. Attention was at once given to the reform of the service-books of the Church. Two prayer-books, compiled partly from the old Latin Uses of the Church of England, had been set forth in 1549 and 1552, but had been suppressed in the reign of Mary. After much deliberation, it was determined to make the second of these the basis of the Prayer-book, which was henceforth to be in English. The reforms in doctrine to which allusion has been made were indeed carried out, but care was taken to avoid touching any part of the common faith of Christendom. The famous principle of Vincent of Lerins, of universal acceptance as the test of Christian truth, was affirmed, and the authority of general councils was acknowledged. These arrangements received the approbation of Convocation and Parliament. Concessions had been made to both the extreme parties—to the Puritans, in adopting the second instead of the first prayer-book of Edward VI.; to the Roman Catholics, in leaving out certain expressions which were justly obnoxious to them—and it was thought that religious unity would thenceforward prevail in England.

This settlement, the joint work of Convocation and Parliament, was accepted by the great body of the nation; and, since all men continued to frequent the parish churches for about ten years, it was hoped that the unity of the English Church would continue unbroken. In 1570, however, after the excommunication of Queen Elizabeth by Pius V., the party afterward called Roman Catholics, acting under the direction of the pope, separated from the church. In those ages politics and religion were so singularly intermingled in Western Europe that any religious agitation commonly involved plots and treasons against the state, and sometimes open war. In this respect England was no better nor worse than other countries; and in this condition of affairs the true motive is to be found for the stringent laws which were enacted and put in force against "popish recusants." The penal laws, however, were the work of the state rather than of the Church; and they were intended not as a measure of unnecessary persecution, but as a precaution against the plots for the destruction of queen and government, which followed one another in quick succession.

Some of the extreme Protestants followed the example of separation in 1580 under the leadership of Robert Brown, who, however, returned to the Church and died in its communion. They were at first called Brownists or Separatists, afterward Independents, and finally Congregationalists. Others remained in the Church and demanded a further reformation, which, however, has never been conceded. The Prayer-book has indeed been twice revised, but the tendency on both occasions has been to bring it into nearer accordance with the first book of Edward VI., which is supposed to have contained the true sentiments of the earlier Reformers.

The remaining history of the Church of England may be passed over briefly. After its suppression during the civil war—the success of which has, by some writers, been attributed to a temporary though secret combination between the extreme sections of its enemies—it was restored in 1660, since which time no change has been made in its doctrine or discipline. In 1662 the Book of Common Prayer, as now established, was set forth. The changes which were made in this book were in the direction of a clearer setting forth of the Catholic position of the Church, and expressly made the reception of episcopal ordination necessary for holding benefices. The Act of Uniformity emphasized this position of the ordinal, thus summarily ejecting the intrusive ministers of various ordinations, or of none at all, from the cures they had occupied during the great rebellion. The exciting scenes of the sixteenth and seventeenth centuries, the successive attempts to restore the supremacy of the pope, culminating in the ill-advised measures of James II. and the consequent irritation of the people, led, first, to a reaction, and after the revolution of 1688 to a long period of religious indifference. The latter part of the seventeenth century was an age of immorality; the earlier part of the eighteenth was a time of negligence and indifference. Since the middle or early part of the eighteenth century there have been three great religious revivals. The first was that of John and Charles Wesley, both priests of the Church of England, who set themselves to the task of developing personal holiness (the great want of an age of religious indifference and immorality) in the members of their Church. Their labors were crowned with great and immediate success; but, partly by reason of the absence of encouragement from the leaders of the Church, and partly from the impatience of some of their own followers, they failed in accomplishing their designs. The Wesleys themselves lived and died in the communion of the Church, but many of their followers withdrew from it and formed a new body of Dissenters.

The second revival was that of the "Evangelicals," as they were called, about 1798, of which such men as the Rev. Charles Simeon, of Cambridge, and Bishop Daniel Wilson, Metropolitan of Calcutta, were the leaders. The guiding thought in this movement also was the development of personal holiness. The movement was well adapted to the times, and may be regarded as successful while it lasted, but it lacked the elements of permanence. Its weakness lay in neglecting definite dogma, which experience has shown to be essential to any form of religion. The work of these good men, however, is worthy of all reverence. They accomplished a great deal in their generation, and they prepared the way for the revival which is now in progress.

The third revival was the movement indicated by the term TRACTARIANISM (*q. v.*). While the aim of the Oxford divines, as its leaders were called, was, equally with the others, the development of personal holiness, they endeavored to avoid the tendency of the first to schism, and of the second either to neglect dogma altogether or to give undue prominence to one or two points of Christian doctrine. Hence they naturally dwelt much upon the authority of the Church; and their object seems, in their early history (1833–63), to have been simply to teach the Church to carry out in practice the doctrine, discipline, and manner of life which are set forth in the Prayer-book. Later, however, the leaders of this school have given much thought to the relations of the Church of England to the rest of Christendom, and to the question of the restoration of visible unity among Christians. These points are discussed in the *Eirenicon* of the celebrated Dr. Pusey. Hence much attention has been given to the study of church history, and the history of the English Church may be said to have been rewritten since 1833.

Both these schools still exist, and are commonly known as Low Church and High Church. The former claims, and no doubt justly, to be the representative of the Protestant or Puritan part of the Church in the reign of Elizabeth; the latter, of the Catholic or national school, which then gained the predominance, and, with the exception of the forty years of the evangelical revival, has always retained it. The peculiar character of the former is its claim to great liberty of private judgment; of the latter, its deference to authority. With the exception of a small party known as Broad Church, of which Frederick William Robertson, of Brighton (d. 1853), and Frederick Denison Maurice (d. 1872) were among the founders, and Dean Stanley was one of the leaders, and which is somewhat eclectic in its teachings, these two great historical schools may be regarded as comprising the whole Church of England.

The discipline of the Church of England has continued unchanged for many centuries. The bishoprics, with the addition of two or three which were created by Henry VIII., and those of Ripon, Manchester, St. Albans, Truro, Liverpool, Wakefield, Newcastle-on-Tyne, and Southwell, erected within the nineteenth century, still remain in their ancient seats; and the succession of the bishops, of whom lists are extant, is traced in them to the sixth or seventh century. England and Wales are divided into two provinces, under the Archbishops of Canterbury and York. The former has under him a larger number of bishops than the latter. The episcopal incomes amount to about £156,000. The population of England and Wales is about 30,000,000; the church sittings are estimated at over 6,000,000. The actual population connected with the Established Church is about 18,000,000. The system of parishes introduced by Theodore, the seventh Archbishop of Canterbury (668–693), still exists. The number of parish priests and curates is upward of 25,000. There are about 11,600 schools under the care of the Church, and 30 training colleges for teachers. The canon law, derived from the acts of successive English councils, antedating Parliament and the English constitution itself, still forms the basis of the ecclesiastical system. The annual revenue of the Church, the greater part of which is derived from ancient endowments, is estimated at £7,000,000. During 1900 the amount received by the Church by voluntary contribution for elementary education was £1,177,288 15*s.* 7*d.*: the contributions to foreign missions, exclusive of funds derived from rents, dividends, or interest, balances on hand from previous years, or foreign contributions, was £772,246 9*s.* 1*d.*; amount of voluntary offerings for the building, restoration, and furnishing of churches, endowment of benefices, building of parsonages, and the enlargement of burial-grounds, about £1,000,000; amount of voluntary offerings for home missions, temperance work, clubs, and charities, about £548,881 4*s.* The total voluntary contributions for the year 1900 amounted to £7,464,434 4*s.* 11*d.*

The great achievement of the English Church during the nineteenth century has been the increase of the colonial episcopate. The first colonial bishop was Dr. Charles Inglis, consecrated Lord Bishop of Nova Scotia Aug. 12, 1787. Bishop Heber was sent to Calcutta in 1814. In 1892 there were 77 dioceses in the British colonies and in missions, and about 3,500 clergymen. These numbers are constantly increasing.

From time immemorial the Archbishop of Canterbury has been held to be entitled to the dignity, though he has never borne the name, of a patriarch. That this is something more than an empty dignity would seem to be implied by the unanimity with which Archbishop Longley was accepted as a president of the conference or synod of bishops which sat at Lambeth, London, in 1867, and by the general disposition to consider him as the spiritual head of the Anglican communion, saving, of course, the rights of autonomous churches. This includes the Church of England (with Wales), of Ireland, the Church in the colonies, and the Episcopal Church in Scotland and in the U. S. of America. These churches, while they are one in doctrine, regulate their internal affairs for themselves, yet they may meet, as they have done thrice, in a synod of their bishops when any question of general interest arises. The whole number of episcopal sees and jurisdictions, as at present arranged, is nearly or quite 200, though the actual number of bishops, including those retired from their sees but still living and often actively at work, is considerably larger. There are nearly or quite 30,000 priests and deacons.

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Centuries of the Church of England (Oxford, 1881). Especially on church-law, see Blunt and Phillimore, *Law of the Church of England* (2 vols., London).

BEVERLEY R. BETTS.
Revised by WILLIAM STEVENS PERRY.

England, JOHN, D. D.: ecclesiastic; b. in Cork, Ireland, Sept. 23, 1786. He was educated at Carlow College, and took orders in the Roman Catholic Church in 1808. He was soon after appointed lecturer at the North Chapel and chaplain of the prisons, and in 1809 he began the publication of the *Religious Repertory*, a monthly. He was greatly distinguished for his zeal, his benevolence, and his bold championship of Catholic emancipation. He was also a prominent journalist, and was once fined £500 for his boldness in discussing political questions. In 1820 he became Bishop of Charleston, S. C., and there founded the *Catholic Miscellany*, the first journal of his Church in the U. S. His works, in five volumes, appeared in Baltimore 1849. Bishop England's heroic behavior during an epidemic of yellow fever in Charleston endeared him to all classes of citizens. He was a man of great energy and profound learning. D. in Charleston, S. C., Apr. 11, 1842.

England, Sir RICHARD, G. C. B.: general; b. in Detroit, Mich., in 1793; son of Lieut.-Gen. Sir Richard England, an officer of Irish origin, distinguished in the British service during the Revolutionary war in North America. The younger Sir Richard entered the British army at the age of sixteen, and served against Napoleon I. He subsequently gained distinction in South Africa, India, Afghanistan, and the Crimea, and was made a full general in the army in 1863. He also became a grand officer of the Legion of Honor, colonel of the Forty-first Foot, etc. D. Jan., 1883.

Engles, WILLIAM MORRISON, D. D.: author; b. in Philadelphia, Pa., Oct. 12, 1797; graduated at the University of Pennsylvania in 1815. In 1820 he became pastor of the Seventh Presbyterian church in Philadelphia; in 1834 editor of the *Presbyterian*; and in 1863 president of the Presbyterian Board of Publication. He published *Records of the Presbyterian Church* (Philadelphia, 1840); a *Bible Dictionary* (1850); *Sailor's Companion* (1857); *Sick-room Devotion* (1846); *Soldier's Pocket-book* (1861); and other works, chiefly devotional. D. in Philadelphia, Nov. 27, 1867.

Englewood, eng'l-wŏŏd: town and railway junction, now incorporated in Chicago; Cook co., Ill. (for location of county, see map of Illinois, ref. 2–C). It is the site of the county normal school (opened in 1868), which has a normal department, a training-school, and a high-school department.

EDITOR OF "CALL."

Englewood: city (1896); Bergen co., N. J. (for location, see map of New Jersey, ref. 2–E); on N. R. R. of New Jersey; 14 miles N. of Jersey City, near the Palisades of the Hudson river. Englewood township was organized in 1871 from part of Hackensack. Pop. (1890) 4,785; city (1900) 6,253.

English: a term used in billiards. See BILLIARDS.

English, EARL: rear-admiral U. S. navy; b. in Burlington co., N. J., Feb. 18, 1834; entered the navy as a midshipman Feb. 25, 1840. He was in the engagement with the Barrier forts at the entrance to the Canton river, China, in 1856, and during 1862 and 1863 commanded several vessels of the Gulf blockading squadron. In 1864 and 1865 he commanded the steamer Wyalusing of the North Atlantic blockading squadron, and in Oct., 1864, took part in the capture of Plymouth, N. C. Retired Feb. 18, 1886. D. at Washington, D. C., July 16, 1893.

English, GEORGE BETHUNE: adventurer and author; b. at Cambridge, Mass., Mar. 7, 1787; graduated at Harvard in 1807; was admitted to the bar, next was licensed to preach; published in 1813 *The Grounds of Christianity Examined*, a work favoring Judaism, which was replied to by Edward Everett and others, and was followed on English's part by *Five Smooth Stones out of the Brook* (1815). After editing a newspaper for a short time, English entered the U. S. navy, but soon resigned to enter the Egyptian service, and gained distinction as an officer of artillery. Subsequently he was U. S. agent in the Levant; returned to the U. S. in 1827. Among other works published by him was a *Narrative of the Expedition to Dongola and Sennaar* (1823). D. in Washington, D. C., Sept. 20, 1828.

English, JAMES EDWARD: statesman; b. in New Haven, Conn., Mar. 13, 1812; became a successful merchant and manufacturer; Democratic member of Congress 1861–65; Governor of Connecticut 1867–69 and 1870–71. He was appointed to fill a vacancy in the U. S. Senate caused by the death of Orris S. Ferry, Nov. 21, 1875, and was nominated for Governor of Connecticut by the Democrats Aug. 18, 1880. D. in New Haven, Mar. 2, 1890.

English, THOMAS DUNN: poet, lawyer, and physician; b. in Philadelphia, Pa., June 29, 1819; graduated at the medical school of the University of Pennsylvania 1839; was admitted to the Philadelphia bar in 1842; edited some short-lived periodicals; became in 1859 a medical practitioner near New York city. Among his works are several successful dramas, numerous novels, among them *Walter Woolfe* (1844), a volume of poems (1855), and *American Ballads* (1882). The best known of his poems is the popular ballad, *Ben Bolt*.

Revised by H. A. BEERS.

English, WILLIAM HAYDEN: lawyer and politician; b. at Lexington, Ind., Aug. 27, 1822; educated at South Hanover College; practiced law, and was postmaster of Lexington, Ind.; clerk of Indiana House of Representatives in 1843; was four years in the U. S. Treasury department; secretary in 1850 of convention at Indianapolis to revise the constitution of Indiana; member of Indiana Legislature in 1851, and of the U. S. House of Representatives in 1852; was three times re-elected to the latter, retiring in 1860; president of First National Bank of Indianapolis 1863–87; was nominated for Vice-President of the U. S. by the Democratic convention at Cincinnati, O., June 24, 1880. He was president of the Indiana Historical Society, and the author of works on the History and Constitution of that State. D. in Indianapolis, Feb. 7, 1896.

English Channel (in Fr. *La Manche*, the sleeve): that portion of the Atlantic which separates England from France. It extends on the English side from Dover to Land's End, and on the French from Calais to the island of Ushant. On the E. it communicates with the German Ocean by the Strait of Dover, 21 miles wide, and on the W. it opens into the Atlantic by an entrance 100 miles wide. Its greatest width is about 150 miles. On the English side, off the coast of Hampshire, lies the beautiful Isle of Wight. Guernsey, Jersey, and the other Channel islands are situated off the north coast of France. The channel has a current that sets from the westward, and it is noted for its roughness, which causes its passage to be dreaded by tourists.

English Gothic, or **Gothic**: See FAN VAULTING.

English Harbor: one of the finest ports in the West Indies; on the south side of the island of Antigua; in lat. 17° 3′ N., lon. 61° 45′ W. It is capable of receiving vessels of the largest class, has a dockyard and a naval hospital, and is perfectly sheltered in all winds.

English Language: the language of the people descended from the Germanic tribes which, in the fifth century or earlier, took possession of the greater part of the island before known as Britain. From the time of their settled possession of that country their language was called English, and their land England, at home and abroad. The term Anglo-Saxon, employed before the year 1000 to distinguish the Saxons of England from those of the Continent, but never to designate their language, was, on the revival of Old English learning after 1600, employed by historians and philologists to denote the entire English people and language before the Norman conquest. The name Anglo-Saxon, properly understood, never signified a union of Angles and Saxons, but, as stated above, English Saxons; it is important to bear this fact in mind, since the opposite view is suggested by the fact that the invaders of England were chiefly composed of two tribes, the Angles and the Saxons, with whom, in smaller numbers, were another tribe called the Jutes, of whom little more is known than their name. As nearly as can be ascertained, the Saxons came from the region between the Elbe and the Rhine, the Angles from the district still called Angeln, in the south of Schleswig, and the Jutes from the north of Schleswig.

Affinities of Native English.—These tribes were an offshoot of that branch of the Indo-European, or Aryan, race known as the Germanic or Teutonic family, which itself branched into two divisions—the East Germanic and the West Germanic. To the East Germanic branch are assigned the Scandinavian tongues, subdivided into East and West Scandinavian, and the Gothic. The Scandinavian division went northward; its representatives are now the people of Norway, Sweden, Iceland, and Denmark. The Gothic branch was the southernmost. It has perished by absorption, and the only remnants of its language, which has been dead for nearly a thousand years, are a mutilated translation of the Gospels, St. Paul's Epistles, Esdras, and Nehemiah, made by Bishop Ulfilas about A. D. 350, together with a calendar. The West Germanic branch filled the country now somewhat vaguely known as Germany. Of this two branches are distinguished—the High Germanic, the language of Upper or Southern Germany, and the Low Germanic, the language of Northern Germany and the Netherlands. Among the various subdivisions of Low Germanic the chief ancient ones, besides Old English, are the Old Saxon and Frisian; the chief modern ones are Dutch and Flemish. The English language is therefore, by origin and main affinity, a Low German tongue. Among living tongues it is nearest of kin to the Frisian, which is still spoken in a few places on the shore of the North Sea, on the borders of Holland, nearest to Denmark. Accordingly, English may be classed as a member of the Anglo-Frisian group of the Low Germanic languages (cf. Siebs, *Zur Geschichte der Englisch-Friesischen Sprache*, Halle, 1889). The English, or "Anglo-Saxon," language must have been spoken in the country from which the Angles and the Saxons came, but no trace of it was left there, chiefly because the emigration of the people to Britain was so complete that it left the country for a time almost deserted.

Periods of English.—The changes which have taken place in the language have indeed been considerable, but they have been effected so gradually that it is difficult to lay down fixed lines of demarkation between the successive stages. Three periods, however, stand out with sufficient clearness in their main features, though they shade off at beginning and end in a manner which precludes the assignment of any other than approximate dates. The first extends from the English occupancy of Britain till about the year 1200, and is known as Old English. The second extends from 1200 or thereabouts till the neighborhood of 1500, and is called Middle English. The third extends from 1500 to the present day, and is that called Modern English. There are different points of view from which these periods might be characterized, but the accepted basis of classification is inflection. According to this, Old English is the period of *full* inflections (*mōna*, *sunne*, *sunu*), Middle English is the period of *leveled* inflections (*mōne*, *sunne*, *sune*), and Modern English is the period of *lost* inflections (*moon*, *sun*, *son*). Each of these periods may in turn be subdivided into *early* and *late*, and, in addition, periods of transition between the principal stages may be recognized. The latest attempt to assign dates to these various periods is by Dr. Henry Sweet, in his *New English Grammar*. His classification is as follows:

Early Old English (English of Alfred)	700–900
Late Old English (English of Ælfric)	900–1100
Transition Old English (English of Layamon)	1100–1200
Early Middle English (English of the Ancren Riwle)	1200–1300
Late Middle English (English of Chaucer)	1300–1400
Transition Middle English (Caxton English)	1400–1500
Early Modern English (Tudor English; English of Shakspeare)	1500–1650
Late Modern English	1650–

Dialects.—In Old English there were two main dialects, possessing strongly marked characteristics, the Northern and the Southern, or the Anglian and the Saxon. The Anglian dialect, which was more nearly akin to the Frisian and the Scandinavian, comprised the Northumbrian and the Mercian; the Southern dialect, more archaic and less progressive, included the West Saxon and the Kentish. The chief representatives of these dialects in the Old English period are the Northumbrian and the West Saxon respectively; of each of these there are specimens representing both an early and a late period, while of Mercian, for example, only the later period has remains, and these suspected of admixture with West Saxon. Northumbrian was the literary language of England in the seventh and eighth centuries, but was largely supplanted by West Saxon in the ninth, tenth, and eleventh; hence it is that most of the poetry, though probably composed in Northumbrian, is now extant only in a West Saxon transcription, in which, however, Northern elements and forms can still be discerned.

In the Middle English period a third principal dialect was added to the Northern and Southern, namely, the Midland or Mercian. The Mercians, men of the "march" or boundary (cf. the Welsh and Scottish Marches), inhabited the district between the Thames and the Humber, while the Northumbrians, as the etymology of the name signifies, dwelt north of the Humber, as far as the Firth of Forth, and the Saxons were settled for the most part south of the Thames, and well on toward the west. The Mercian of the older period, as already stated, is represented by but scanty and uncertain remains, but in the Middle English time, under the name of the Midland speech, it emerges into prominence, and becomes the basis of the standard or literary English tongue. The existence of the dialect, as well as one of the reasons for its prominence, is authenticated by the testimony of Higden, a writer of the first half of the fourteenth century. The passage, as translated by John Trevisa, is in part as follows: "Also Englysch men . . . hadde fram the bygynnyng thre maner speche, Southeron, Northeron, and Myddel speche (in the myddel of the lond), as hy [i. e. they] come of thre maner people of Germania. . . . Men of the Est with men of the West, as hit [i. e. it] were undur the same party of hevene, acordeth more in sounyng of speche than men of the North with men of the South; therfore hyt is that Mercii, that buth [i. e. beeth, are] men of Myddel Engelond, as hit were parteners of the endes, undurstondeth betre the syde longages, Northeron and Southeron, than Northeron and Southeron undurstondeth eyther other." The emergence of the Midland dialect was accompanied by an all but total disappearance of the Northern; that is, from toward the end of the tenth century till toward the end of the thirteenth no Northumbrian documents are found; the Southern, on the other hand, continued to flourish.

In Modern English, the Scotch of Burns and other Lowland writers represents the Northumbrian; the standard literary language in the main represents the Mercian or Midland; while the Southern may be studied in William Barnes's *Poems of Rural Life.* The following specimen of the modern Southern dialect is from Barnes's lyric, *The Spring*:

When wintry weather's all a-done,
An' brooks do sparkle in the zun,
An' nâisy-builden rooks do vlee
Wi' sticks toward their elem tree;
When birds do zing, an' we can zee
Upon the boughs the buds o' spring—
Then I'm as happy as a king,
A-vield wi' health an' zunsheen.

But besides the modern English dialects represented in literature, there are a large number which exist only as forms of popular speech in the mouths of the illiterate, and which stand for varieties or blendings of the great dialects described above.

Old English.—Old English (700–1200) was the most highly cultivated of the Teutonic languages of its time; it was adequate for the accurate and easy translation of the Latin classics, and it has original literature worthy of study. Its chief interest, however, is as the mother tongue of the English. It has given us the names of the objects, relations, and affections which we speak of most, the words laden with the dearest associations, the idioms on which the beauty of our poetry and the power of eloquence, wit, and humor depend. From it almost all our grammatical forms are derived. It furnishes modern standard English with its strength, its stability, its vitality, and its real character. It is the distinctive element of our speech; and not only so, but it forms, except from a lexicographer's point of view, the bulk of the spoken language. If all other elements were taken away, the language would still exist with its life and vigor unimpaired. We could live and love and hate and work and play and worship, and express all our wants and feelings, tell tales and sing songs. But were this element to be removed, the language would fall to pieces in heterogeneous, disconnected, and lifeless masses. And yet in all copious dictionaries of the English language the words of other than purely English origin constitute three-fourths of the whole vocabulary. This seeming paradox is owing to the fact that all or almost all our words of commonest and most necessary use, including those particles which connect the others and modify their meaning, are pure English, while those which belong to literature, science, and art, which express abstract ideas and the subtle variations of thought, are, in the main, of foreign, and chiefly of Romanic, origin. The words which are used by all, men, women, and children, learned and unlearned, and used by all most often, belong to the former class; those which are used chiefly by the more or less learned classes, and much the greater number of them rarely even by these, belong to the latter. This is a phenomenon which appears in no other language, at least in anything like so great a degree. It makes modern English a two-sided—and, as we have words of both classes for many nearly identical thoughts and things—almost a double-faced language.

Influences Affecting Old English.—The English language, as it was taken into Britain by the men who were to supplant the Britons and to change the very name of the country, was simple and unmixed, except for a small proportion of Latin words, acquired by our continental ancestors through their intercourse with the Romans; and, for the most part, it so remained for centuries. The Celtic dialect of the subdued Britains had but little influence upon the sturdy speech of the Teutonic invaders, who ere long filled the whole island from the Grampians to the English Channel with their language as with themselves.

More influence was exerted by the Latin, which was constantly being read, translated, and imitated by learned men, who were then almost exclusively the clergy. Soon after the landing of Augustine and the missionaries accompanying him (A. D. 597), excellent schools were established, and the culture of the time, largely contained in the works of the Christian Fathers, but to some extent also in classics like Vergil and Horace, was enthusiastically fostered in England. In the year 669 Archbishop Theodore, a native of Tarsus, in company with Abbot Hadrian, an African by birth, arrived at Canterbury, and immediately established a school. The historian Bede relates of them (bk. 4, ch. ii.): "And forasmuch as both of them were, as has been said before, well read both in sacred and secular literature, they gathered a crowd of disciples, and there daily flowed to them rivers of knowledge to water the hearts of their hearers; and together with the books of Holy Writ, they also taught them the arts of ecclesiastical poetry, astronomy, and arithmetic. A testimony of which is that *there are still living at this day some of their scholars, who are as well versed in the Greek and Latin tongues as in their own, in which they were born.*" The same statement is explicitly made concerning Abbot Albinus (bk. 5, ch. xx.) and Bishop Tobias (bk. 5, ch. xxiii.). The consequence is that there is found in the Old English writings no inconsiderable number of Latin words, chiefly those in ecclesiastical use, many of which had been naturalized from the Greek. Prof. Lounsbury says (*History of the English Language*, p. 42): "Before the Norman Conquest six hundred words at least had been introduced from Latin into the Anglo-Saxon. Some of them occur but once or twice in the literature handed down, others are met with frequently. Were we to include in this list of borrowed terms the compounds into which the borrowed terms enter, the whole number would be swelled to three or four times that above given. It is also to be marked that not only were nouns directly borrowed, but also adjectives and verbs, though to a far less extent." This computation doubtless includes the words which our ancestors brought with them from the Continent, and which have only recently been distinguished from the later borrowings (Paul, *Grundriss der Germanischen Philologie*, vol. i., p. 309 ff.), but a goodly residue will still be left, including words not confined to ecclesiastical usage, but yet familiar to the monks and clergy. From these classes may be instanced such as *mæsse*, mass (Lat. *missa*); *prēost*, priest (Lat. *presbyter*); *mynster*, monastery (Lat. *monasterium*); *sealm*, psalm (Lat. *psalmus*); *scōl*, school (Lat. *schola*); *popæg*, poppy (Lat. *papaver*); *pihten*, comb (Lat. *pecten*); *rose*, rose (Lat. *rosa*); *dihtian*, compose (Lat. *dictare*), etc. But the influence of Latin upon Old English was not confined to the vocabulary. It must also have had a considerable effect upon the syntax, though the latter has not been sufficiently investigated to enable positive and specific statements to be made.

Less important was the Scandinavian influence due to the incursions and settlements of the tribes which history conveniently comprehends under the general title of the Danes. They began their inroads near the close of the eighth century, and effected a permanent settlement as early as 855. They at last distributed themselves over the northeastern part of the island, and even obtained control over it, under Cnut, for about fifty years. When they were driven out as a ruling power they left behind them, of course, many descendants, and also memorials of their presence in many words which had been taken into the language, and in many names of places. The termination *by*, as in Derby, Whitby, Naseby, Holdenby, etc., marks their presence, but so do also a number of words occurring in Late Old English, especially in the English Chronicle and the Laws. Examples are *eorl*, earl (Old Norse *jarl*); *cnīf*, knife (O. N. *knīfr*); *ūtlah*, outlaw (O. N. *ūtlagr*); *wrang*, wrong (O. N. *vrang*). A full list of the words thus far discovered may be found in Paul, *Grundriss der Germanischen Philologie*, vol. i., pp. 786–787, though this by no means represents all that must have been borrowed before the Norman conquest, since literature, and especially if scanty in amount, is but an imperfect record of speech, and the large number of Scandinavian words found in the Middle English period points to the same conclusion.

A Specimen of Old English Prose.—Before stating the grammatical characteristics of Old English, a short specimen will be given of the language in its Late Old English stage:

"Ðā-ðā hig fērdon, ðā cōmon sume ðā weardas on ðā ceastre, and cȳðdon ðǣra sācerda ealdrum ealle ðā ðing ðe ðǣr gewordene wǣron. Ðā gesamnodon ðā ealdras hig and worhton gemōt, and sealdon ðǣm þegnum mycel feoh, and cwǣdon, Secgeað ðæt hys leorning-cnihtas cōmon nihtes, and forstǣlon hyne, ðā wē slēpon."

This passage is not to be understood by any reader, however intelligent and well instructed, who has not made a special study of the language in which it is written, although its meaning is familiar to almost every person, literate or illiterate. Only three words, *and*, *we*, and *hys*, would seem to him at all vernacular, and yet it was the everyday English of English people who lived in England. It is the Old English version of verses 11, 12, and 13 of Matthew, ch. xxviii. with our present version of which it would be well to compare it:

"Now while they were going, behold, some of the guard came into the city, and told unto the chief priests all the things that were come to pass. And when they were assembled with the elders, and had taken counsel, they gave large money unto the soldiers, saying, Say ye his disciples came by night and stole him away while we slept."

Strange and foreign to us as at first the passage seems—as foreign as French or German—a brief examination of it will make clear to any person, although entirely unacquainted with Old English, that it is written in a tongue with the accents of which he is not entirely unfamiliar. *Fērdon* is fared, went; *cōmon*, came; *sume*, some; *weardas*, wards, watch; *ceastre*, caster, city (as in Lancaster); *sācerda*, priests (sacred persons); *ealdrum*, elders; *ealle*, all; *wǣron*, were; *worhton*, worked; *gemōt*, a meeting; *sealdon*, sold, gave; *þegnum*, thanes; *mycel*, mickle, much; *feoh*, fee, pay, money; *secgeað*, say; *leorning-cnihtas*, learning-knights, disciples; *nihtes*, (o') nights; *forstǣlon*, stole; *hyne*, him; *slēpon*, slept. It thus appears that almost all the words in this passage are essentially English now, though it must be borne in mind that the Modern English word is not in all cases the *direct* descendant of the Old English word here given (e. g. *worhton* gives *wrought* rather than *worked*, and *him* and *slept* come from *collateral* forms of *hyne* and *slēpon*, that is from the dative *him* and the *weak* preterit *slǣpton*). In the lapse of eleven hundred years they have changed somewhat in form, and somewhat, but not vitally, in meaning.

Pronunciation of Old English.—The vowels sounded nearly as in German: *a* as in *far*, but shorter; *ā* as in *far*; *æ* as *a* in *glad*; *ǣ* as *a* in *dare*; *e* as in *let*: *ē* as in *they*; *i* as in *dim*; *ī* as *ee* in *deem*; *o* as in *opine*; *ō* as in *holy*; *u* as in *full*; *ū* as *oo* in *fool*; *y* like the French *u* or the German *ü*; *ȳ* the same sound prolonged.

The diphthongs *ea*, *eo*, *ie*, both short and long, are pronounced like combinations of the respective vowels; but the stress is always upon the first vowel of the combination, the second reducing to a neutral sound, scarcely more than a glide. The consonants are pronounced nearly as in modern English. Still, it must be observed, *c* is sometimes *k*, sometimes nearly *ch*; *f* between vowels, occasionally elsewhere, has the sound of *v*, *s* of *z*, and ð (þ) of *th* in *the* (otherwise as *f*, *s*, and *th* in *thin*); *g* is sometimes hard *g*, sometimes nearly *y*; *cg*, which stands for *gg*, almost like *dg* in *bridge*; *h*, when not initial, sounded like *ch* in German *ich*, *auch*. It is to be noted that there are no silent letters in Old English; every vowel and consonant was pronounced, though the vowels of unstressed syllables had a less distinct sound.

Phonology of Old English.—The phonological system of Old English, or the relations of its speech-sounds among themselves and to those of its sister languages, is too complicated for exposition here. The most important modifications to which vowels are subject through the influence of other sounds within the same words are umlaut and breaking. Umlaut is the change effected in the vowel of a root-syllable by the anticipation of a vowel of a following unstressed syllable. When the latter vowel is *i* (or *y*, represented by *j*) the change is called *i*-umlaut; when *u* or *o*, these vowels give name to the umlaut. The latter is less important; the former causes such phenomena as are observable in *man, men*; *goose, geese*; *mouse, mice*. In Old English these pairs occur as *mann, menn*; *gōs, gēs*; *mūs, mȳs*. In a prehistoric stage of the language they would have been *mann, manni*; *gōs, gōsi*; *mūs, mūsi*. The tendency to anticipate the sound of *i* (ĭh) while pronouncing the root-syllable led to a blending of it with that of the root-vowel: *a* blended with *i* gave *e*; *ō* with *i*, *ē*; *ū* with *i*, *ȳ*. In the *u*- and *o*- umlaut the process was the same, but the number of words affected was much smaller.

Breaking is the effect produced by *l* and *r* when followed by a consonant, and by *h* when final or followed by a consonant, upon a preceding *e* or *æ* (from *a*). This effect is due to a deep, guttural pronunciation of the consonant, which rendered it difficult to pass from the vowel sound to it without the generation of an intermediate vowel. This intermediate vowel, neutral or obscure in sound, was represented by *a* or *o*. Thus *hærd*, hard (for *hard*), became *hæard*, and *erðe*, earth, became *eorðe*; *hæard* was then spelled *heard*, though the sound of *æ* was retained. A similar phenomenon may be observed in Shakspeare, where certain monosyllables containing *l* or *r* are pronounced almost as disyllables. Compare, for example, the following line from Henry VIII. (iii. 2, 117):

> Strikes his breast hard and anon he casts,

where *hard* is pronounced almost like *hah-urd*, as the meter shows.

Ablaut is another phonological trait of Old English, though it did not originate there. It is the vowel-variation familiar to us in such words as *sing, sang, sung*; *drive, drove, driven*. Its cause is obscure, and any attempt at explanation would transcend our limits.

In general, it may be said that the influence of neighboring sounds upon each other is greater than in Modern English, and hence the language appears more unstable and, as it were, fluid. The fixity of Modern English spelling, however, tends to conceal the changes which are now taking place.

Old English an Inflectional Tongue.—Old English was a synthetic or inflectional language; that is, it, like the Latin and the Greek, expressed time, condition, number, and person by changes in the forms of words, and only exceptionally by the use of "auxiliary" words.

Thus, in the passage quoted above, *-on* is the sign of the pret. plural of the verbs; *-as* (*weardas, cnihtas*) indicates the nom. (acc.) plur. of the most numerous class of strong nouns; *-a* (*sācerda*) is the sign of the genitive plural; *-um* (*ealdrum*) that of the dative plural, etc.

Inflection of Nouns.—There was a threefold grammatical gender in Old English. Besides, a noun of any gender might be of either the strong or the weak declension. In the weak declension the oblique cases were formed by the addition of *n*, with or without other letters, as the case might be; in the strong declension *n* was not used for this purpose. There were four cases: nominative, accusative, genitive, and dative, the first and second being often alike. The dat. plur. always ended in *-um*, and the gen. plur. in *-a* or *-ena*. The inflection of a strong masculine, *fisc*, fish, is as follows: nom. acc. *fisc*, gen. *fisces*, dat. *fisce*; pl. nom. acc. *fiscas*, gen. *fisca*, dat. *fiscum*. If the stem contained *æ*, as in *dæg*, day, this vowel became *a* in the plural. Neuters of this declension inflect like masculines, except that the pl. nom. acc. is formed in *-u*, which is lost after a long root-syllable: *scipu*, ships; *word*, words. Disyllabic nouns generally lose the vowel of the second syllable before all endings, when the stem is long by nature or position, if the second or unstressed syllable is not long by position: thus nom. *engel*, angel, *dryhten*, lord, gen. *engles*, *dryhtnes*, not *engeles*, *dryhtenes*. There is a class of so-called umlaut masculines which form the dat. sing. and nom. acc. plur. by umlaut of the radical vowel, and without ending, the other cases being regular. Thus *fōt*, foot, has the dat. sing. and nom. acc. plur. *fēt*; *mann*, man, forms the same cases in *menn*, etc.

Strong feminines have a declension of their own. If the stem is short, the nom. sing. ends in *-u*, like the nom. acc. plur. of neuters; if long, it is monosyllabic, again like the same neuters. The declension of *giefu*, gift, is as follows: nom. *giefu*, gen. dat. acc. *giefe*; pl. nom. acc. *giefa*, or *giefe*, gen. *giefa*, sometimes *giefena*, dat. *giefum*. *Glōf*, glove, a long stem, has the oblique cases and the plural like *giefu*. The acc. sing. of a tolerably large class of feminine long stems takes no ending. A few feminines take an umlaut declension, like the masculines mentioned above; among them are *gōs*, goose, *mūs*, mouse, *bōc*, book, *burg*, city. Besides the dat. sing. and nom. acc. plur., these occasionally form the gen. sing. in the same way. These cases of the words specified are accordingly *gēs*, *mȳs*, *bēc*, and *byr*(*i*)*g* respectively, from the first two of which came Mod. Eng. *geese* and *mice*.

The weak declension of masculines is as follows: nom. *oxa*, ox, acc. gen. dat. *oxan*; pl. nom. acc. *oxan*, gen. *oxena*, dat. *oxum*. There are but two weak neuters: *ēage*, eye, and *ēare*, ear; they decline like the masculines, except that the acc. sing. is like the nom. Weak feminines are decidedly fewer than the masculines; they have the nom. sing. in *-e*, instead of the masc. *-a*, but otherwise resemble them in declension.

Proper names, when native, are declined like common nouns; when foreign, they sometimes retain their original declension, either wholly or in part, and are sometimes treated as if native.

Inflection of Adjectives.—Adjectives, like nouns, have two declensions, a strong and a weak, but, unlike nouns, it is the same adjective which takes either strong or weak endings, according to circumstances. Adjectives are inflected weak when in the comparative, and usually when in the superlative, when ordinals, when preceded by a demonstrative, and sometimes when preceded by a possessive pronoun of the first or second person. Otherwise the strong form is used. The weak declension is precisely the same as that of nouns, except that the gen. plur. usually takes *-ra* instead of *-ena*. Adjectives, when strong, are declined like the corresponding nouns of the various genders, with the following exceptions: dat. masc. neut. in *-um*, instead of *-e*; acc. masc. in *-ne*, instead of —; gen. dat. fem. sing. in *-re*, instead of *-e*; nom. acc. plur. masc. in *-e*, instead of *-as*; gen. plur. of all genders in *-ra*.

Adjectives are normally compared by adding *-ra* for the comparative, and *-osta* or *-esta* for the superlative. In some words the stem-vowel of the comparative and superlative takes *i*- umlaut, but this is not the rule. Without umlaut: *heard*, hard, comparative *heardra*, superlative *heardosta*. With umlaut: *eald*, old, *ieldra*, *ieldesta*. From the umlaut forms are derived Mod. Eng. *elder*, *eldest*, as against a newly formed *older*, *oldest*. Besides the regular comparison, there are a few instances of much irregularity.

Numerals.—The cardinals run as follows: *ān*, one; *twēgen*, twain. *twā*, two; *ðrēo*, three; *fēower*, four; *fīf*, five; *siex*, six; *seofon*, seven; *eahta*, eight; *nigon*, nine; *tīen*, ten; *endlefan*, eleven; *twelf*, twelve; *ðrēotīene*, thirteen, etc.; *twēntig*, twenty; *ðrītig*, thirty, etc.; but *hund-seofontig*, seventy; *hund-eahtatig*, eighty; *hund-nigontig*, ninety; then *hund* or *hundtēontig*, hundred; *hundtwelftig*, hundred and twenty, etc.; *ðūsend*, thousand.

The ordinals are *fyrsta* (besides other forms), first; *ōðer*, (literally other), second; *ðridda*, third; *fēorða*, fourth; *fīfta*, fifth; *siexta*, sixth; *seofoða*, seventh, etc.; *ðrēotēoða*, thirteenth, etc.; *twēntigoða*, twentieth, etc.

Inflection of Pronouns.—In the first and second persons the personal pronouns have a dual, which, however, is not of frequent occurrence. The declension of the first person is, in the order nom., gen., dat., acc., as follows: *ic*, *mīn*, *mē*, *mē* (*mec*); dual, *wit*, *uncer*, *unc*, *unc*; plur., *wē*, *ūre*, *ūs*, *ūs*. The second person runs: *ðū*, *ðīn*, *ðē*, *ðē* (*ðec*); dual, *git*, *incer*, *inc*, *inc*; plur., *gē* (*gīe*), *ēower*, *ēow*, *ēow*. The third person has the same plural throughout: *hīe*, *hiera*, *him*, *hīe*. The masc. sing. is *hē*, *his*, *him*, *hine*. The neut. sing. is *hit*, *his*, *him*, *hit*. The fem. sing. is *hēo*, *hi*(*e*)*re*, *hi*(*e*)*re*, *hīe*. The personal pronoun is likewise used in place of the reflexive.

The possessive pronouns are identical in form with the genitive of the personal pronoun. Those formed from the first and second persons are declined like strong adjectives, those from the third are indeclinable.

The article and demonstrative *se*, that, the, is thus declined:

Singular.

<table>
<tr><th></th><th>MASC.</th><th>NEUT.</th><th>FEM.</th></tr>
<tr><td>Nom.</td><td>se</td><td>ðæt</td><td>sēo</td></tr>
<tr><td>Gen.</td><td colspan="2">ðæs</td><td>ðǣre</td></tr>
<tr><td>Dat.</td><td colspan="2">ðǣm (ðām)</td><td>ðǣre</td></tr>
<tr><td>Acc.</td><td>ðone</td><td>ðæt</td><td>ðā</td></tr>
<tr><td>Inst.</td><td colspan="2">ðȳ, ðon</td><td></td></tr>
</table>

Plural.

Nom. Acc.	ðā
Gen.	ðǣra (ðāra)
Dat.	ðǣm (ðām)

The demonstrative ðes, this, is thus declined:

Singular.

	MASC.	NEUT.	FEM.
Nom.	ðes	ðis	ðēos
Gen.	ðisses	ðisses	ðisse
Dat.	ðissum	ðissum	ðisse
Acc.	ðisne	ðis	ðās

Plural.

Nom. Acc.	ðās
Gen.	ðissa
Dat.	ðissum

The interrogative *hwā*, *hwæt*, who, what, is thus declined:

	MASC. FEM.	NEUT.
Nom.	hwā	hwæt
Gen.	hwæs	hwæs
Dat.	hwǣm (hwām)	hwǣm (hwām)
Acc.	hwone	hwæt
Inst.		hwȳ

There is no inflected relative pronoun other than the demonstrative, which sometimes assumes its function.

There are a number of indefinites, which are mostly declined like strong adjectives.

Inflection of Verbs.—Verbs have four moods, the indicative, optative, imperative, and infinitive; two principal tenses, the present and preterit, the former being frequently employed for the future. The passive voice is formed by auxiliary verbs, much as in Modern English. Verbs are divided into strong and weak.

Strong verbs change the radical vowel to form the different tense-stems, like the verbs called irregular in Modern English. As in Modern English the verb *drive* has the preterit *drove* and past participle *driven*, so in Old English the same verb has the preterit singular *drāf* and past participle *drifen*. However, instead of the three tense-stems of Modern English, there are four in Old English for strong verbs, the preterit being subdivided into preterit singular and preterit plural. The four stems of *drīfan*, drive, are:

PRESENT.	PRET. SING.	PRET. PLUR.	PAST PART.
drīf-	drāf	drif-	drif-

which are usually cited under the forms—

INFINITIVE.	PRET. SING.	PRET. PLUR.	PAST PART.
drīfan	drāf	drifon	drifen

Of such strong verbs there are seven classes in all, besides three classes of weak verbs.

Weak verbs in some cases have a variation of vowel between the present and the preterit, but their distinguishing characteristic is that the preterit is formed by the addition to the stem of *-de* for the singular and *-don* for the plural, and the past participle by the addition of *-ed*. Sometimes these endings take a vowel before them, and sometimes a neighboring sound converts the *d* into *t*; but this does not affect the essential nature of the distinction between them and the strong verbs.

The conjugation of a strong verb may be represented by that of *bindan*, bind:

		INDICATIVE.	OPTATIVE.
Pres. sing.	1.	binde	binde
	2.	bindest / bintst	binde
	3.	bindeð / bint	binde
Plur.		bindað	binden
Pret. sing.	1.	band	bunde
	2.	bunde	bunde
	3.	band	bunde
Plur.		bundon	bunden

Imper. sing., *bind*; plur., *bindað*; infin., *bindan*; pres. part., *bindende*; past part., *bunden*; gerund, *tō bindanne*.

The typical scheme for the conjugation of a weak verb may be inferred from that of the strong, if the mode of forming the preterit and past participle is borne in mind.

There are a few preteritive presents from which are derived the modern auxiliary verbs *may*, *can*, etc. Their present is an old preterit, and their new preterit is formed as if the verb were weak.

The optative is used for our potential and imperative, as well as for the optative proper. Relics of these uses are in English: *It were a grievous fault* = It *would be* a grievous fault; *Be it so* = *Let it be so*. But a periphrastic potential with the auxiliaries *may*, *can*, *must*, *might*, etc., is used in Old as in Modern English. The infinitive is regularly without *to*, hence forms with auxiliaries still reject it, as do familiar idioms in which the infinitive is the object of a verb, and *to* is not needed to express purpose or the like.

There was a verbal noun ending in *-ing*, *-ung*, which seems to have been confused with the participle in *-ende*, and given form to our present participle.

The two tenses given above answer for all times—one for all past time, the other for present and future; but forms with auxiliaries are also used. *Hæbbe*, have, for the perfect, and *hæfde*, had, for the pluperfect, are in full use: *he hæfð mann geworhtne*, he has made man.

For the future, *sceal*, shall, and *wille*, will, are common, though seldom free from some meaning of *duty*, *promise*, *determination*, such as indeed goes with them in English. The present distinction between *shall* and *will* in the different persons is not established in Old English. The future perfect is not discriminated.

Adverbs.—Adverbs are frequently formed from adjectives, less frequently from nouns. From adjectives they are formed by the addition of *-e*: *wīd*, wide—*wīde*; of *-lice*: *heard*, hard—*heardlice*; of *-unga*: *eall*, all—*eallunga*, entirely; or an oblique case of an adjective is employed as an adverb; thus the acc.: *genōg*, enough: the gen.: *micel*, much—*micles*, very; the dat.: *miclum*, very. Of nouns the gen. is used: *dæg*, day—*dæges*, by day; or the dat. plur.: *dropmǣlum*, drop by drop; or rarely the inst.: *sār*, sore—*sāre*, sorely. Another important class is adverbs of place, such as ðǣr, there, ð*ider*, thither, the latter being representative of those formed from pronominal stems.

Syntax.—There is nothing in which Old English differs more from Modern English than its syntax, which is that of a highly inflected language like Latin or Greek. The most general laws are common to all speech; a much larger number are common to all Indo-European tongues. The frequency with which different combinations are used by each makes the great difference between them. Apparent anomalies of English syntax may often be easily understood by study of the Old English from which they sprang: *Me thinks I saw him*, seems strange; but in Old English the *thinks* is found to be a different verb from the common English *think*, and to mean *seem*, and govern a dative; *it seems to me* = *methinks*. *He taught me grammar*—tǣcan, *teach*, governs an accusative and dative—*taught to me*. *I asked him a question*—āscian, *ask*, governs an accusative of the person asked. *He went a-hunting*—*a* is the preposition *on* in Old English. *I loved him the more*—*the* is in Old English the instrumental case of the demonstrative (ðȳ, ðē), meaning *by that*. And so examples might be given without end. No difficult point in English syntax can be safely discussed by one who does not know its history.

Metre.—Old English verse reposes on stress and alliteration, rime being only an occasional ornament. There are at least four stressed syllables to each verse, two in each half-line, the half-lines being divided by a cæsura. Two of these stressed syllables in the first half-line and one in the second begin with the same consonant sound or combination, or else with a vowel. Instead of three alliterative sounds to the line, there may be only two, one to each half-line, or four, two to each half-line, and exceptionally more. This metrical structure may be illustrated by a few lines from the poem of *Judith* (202–206), in which the alliterative letters are printed in Italics:

*f*ōron tō ge*f*eohte	*f*orð on gerihte
*h*æleð under *h*elmum	of ðǣre *h*ālgan byrig
on ðæt *d*ægred sylf;	*d*ynedan scildas,
*h*lūde *h*lummon.	Ðæs se *h*lanca gefeah
*w*ulf in *w*alde,	and se *w*anna hrefn.

The effect of which may be rudely represented by the following version:

*F*ared to the *f*ight	*f*orth by the straight road,
*H*eroes with *h*elms,	from that *h*oly city,
At the day-*d*awning;	shields loudly *d*inned,
*R*ang and *r*esounded.	Then *r*eveled the lank one,
The *w*olf in the *w*ood,	with the *w*an bird, the raven.

Effects of the Norman Conquest.—Upon a country harried, distracted, and oppressed by the Danish invasions and tyrannies there came yet another change—that of the conquest by William of Normandy, 1066. The Normans took absolute possession of the island, over which they spread themselves, carrying with them their retainers, and bringing with them their priests; England became a Norman possession and colony, the speech of the conquerors becoming, consequently, that of the court, of courtly circles, and of all public documents and transactions. The Normans belonged to the Scandinavian branch of the Teutonic stock, which had spread northward, even to Iceland. Sailing southward, some of them had taken possession of a province of France, called from them Normandy; but these retained neither their Scandinavian tongue nor manners. They adopted those of the French whose land they had seized. Although they had been in Normandy only about 200 years when William set out for his invasion of England, they then spoke a dialect which is known as Norman-French. For their day they were an accomplished and an elegant people. The Old English tongue, being reduced to the position of a language spoken only by artisans and tillers of the soil, soon lost its distinctive forms and nicer inflections; a process by which, although at the time deteriorating, it was prepared to become with greater ease an analytical language on its amalgamation with the Norman-French. Yet it never became in any sense French or Romanic, but remained in its essence and in its structure English.

Elements of Present English.—The elements of the modern composite English are therefore (1) pure English or "Anglo-Saxon," (2) British or Celtic, (3) Danish or Norse, (4) Norman-French, (5) Latin, (6) Greek, (7) words adopted from all languages, including Arabic, Hebrew, and even those of the savage aborigines of Africa and America. Words of the last class are comparatively few in number; their presence in the language does not at all affect it in its structural or historical aspect, nor do they in any way distinguish it from other Indo-European tongues.

Interfusion of English and French.—For about 100 years after the Norman conquest the conquerors and the conquered held themselves as much as possible aloof from each other—in scorn on the one side and sullenness on the other. And for nearly two centuries more the government of England, politically and ecclesiastically, was carried on in Latin and in Norman-French. These two languages prevailed in the court, in the universities, in Parliament, and in the courts of law; and even in the grammar schools the boys construed their Latin into Norman-French. But as the Normans were few and politic, and the English were many and sturdy, there was unavoidably some mingling of the two languages as well as of the two peoples, and the English gradually prevailed. Political and patriotic motives, which can not be here noticed in detail, combined with the natural influences already mentioned to turn Normans into Englishmen, both in feeling and in speech, until, about 1350, English took the place of Latin in the schools and in the courts of law, and the speech of the whole of the people of England became English. It was not, however, the English which the Norman invader heard at Hastings which obtained this compensating victory, but a speech much modified, and largely mixed with strange elements. The interfusion of the languages was the consequence and the sign of an interfusion of the people. Englishmen did not become Normans—that was impossible, but the Normans became Englishmen—Englishmen of a high and haughty class, a noble order, but still Englishmen; and taking for their own use the language of the people whose country they had also taken for their own use, they brought a large and in most respects a valuable store of words from the speech of their race as their contribution to the common stock. The introduction of French words was largely due, there can be no doubt, to the influence of the priests. These men were dependent upon the Norman nobles; they were their beneficiaries, their chaplains. The higher members of the priesthood, and a very large proportion of the whole order, were of Norman race. Their professional language was Latin, of which Norman-French was a dialect. Their intimate relations with the women and children of the parish, and the reverence felt for their office, gave to these priests an influence upon the language of the country which can hardly be overrated.

No Standard Middle English before 1350.—Of the English written between 1100 and 1350 that of hardly any two authors was alike. The language, having no recognized standard, was used by each scribe according to the mode of speech that prevailed among the people among whom he was bred and for whom he wrote. Writing was therefore as dialectical as speech, and, owing to the immobility of the people and the lack of communication between them, a separation of 50 miles made a difference of dialect which is quite perceptible upon close comparison.

A Specimen of the Transformed Language.—The nature of the change which took place in the language within the compass of 400 years will be, perhaps, better understood by comparing with the Old English version of Matt. xxviii. 11–13, quoted above, another version of the passage—Wycliffe's, as revised by Purvey (about 1388).

"And whanne thei weren goon, lo! summe of the keperis camen in to the citee, and telden to the princis of prestis alle thingis that weren doon. And whanne thei weren gaderid togidere with the elder men, and hadden take her counseil, thei ȝauen to the kniȝtis miche monei, and seiden, Seie ȝe, that hise disciplis camen bi nyȝt, and han stolen hym, while ȝe slepten."

This passage in the Wycliffite version gives some notion of the nature and extent of the changes which have taken place during that period, for, although antiquated, it is unmistakably English—almost as easily understood by any intelligent person as if it had been written to-day, although it was written about 500 years ago. But certain forms in it at once attract attention. They are *hadden* (had), *camen* (came), *telden* (told), *weren* (were), *han* (have). This ending in *en* is no rude or dialectical form of language. It will be found that the nominatives to all these verbs are plural. They are therefore plural forms of the verb which have been dropped since Wycliffe's day. They are a remnant of the elder form of the language; for, looking back to the earlier version, one finds like plural terminations, *on* taking the place of *en*; *fērdon* (fared) *cōmon* (came), *wǣron* (were), *worhton* (wrought), etc. In the Wycliffite version are found also the plural forms *keperis*, *prestis*, *thingis*, *kniȝtis*, which since Wycliffe's day have passed into *keepers*, *priests*, *things*, and *knights*. In the earlier version is found a like syllabic plural in *s*, but instead of *is*, *as*—*weardas* (wards), *ealdras* (elders), *cnihtas* (knights). Besides the forms already remarked upon, there is found in the earlier version *ealdrum*, meaning elders, as *ealdras* does, but elders in another relation, the same which is indicated by a like termination in *ðegnum*. *Secgeað* is "say," but it is "say" imperatively. The old imperative therefore was in *th*, but this had begun to pass away 500 years ago, for Wycliffe writes *seie* (say). Another form in the earlier version attracts attention: *nihtes*, meaning "by night"; but this *nihtes* is a genitive form, and means "of night";* but so even nowadays, among some people, we hear such phrases as "He came o' nights"; and Shakspeare has (*Twelfth Night*, i. 3, 5), "You must come in earlier o' nights." But the fashion of expressing this thought by a change in the word *niht* had in a measure passed away before Wycliffe's day, for he uses a preposition, and writes "by night."

Inflectional Changes Occurring in Middle English.—By this brief comparison of these passages one has a suggestive illustration, though nothing more, of the changes which the Old English language underwent in the course of years, until, about 1525, it assumed substantially the form in which we have it now. Those changes may be succinctly said to have been the gradual disappearance of the case-endings of nouns, except the possessive, which was contracted from *es* to *'s*, and the nominative plural, which was changed from *as* to *es*, and in many words to simple *s*; a like change, but complete, in the adjective, which loses all distinction of the form and the sense of case and of number, and does not conform to or agree with its substantive; the entire disappearance of grammatical gender; the loss of the infinitive and imperative forms of the verb, with the distinctions of persons except in the third person singular; the only other inflectional changes remaining being those of the preterit, and the present or indefinite participle, of weak verbs (*love*, *loved*, *loving*), to which must be added the perfect or definite participle in the strong verbs (*sing*, *singing*, *sang*, *sung*). The verb *to be* is not at variance with this assertion, its several tenses and even persons being taken from three distinct verbs, as appears to have been the case in the whole Indo-European family of speech, the Sanskrit included, from the earliest

* The true genitive of *niht* is *niht* or *nihte*, and *nihtes* is apparently formed by analogy with *dæges*. *Dæges* and *nihtes* means, "of (or by) day and of (or by) night."

ages. Truly inflected case and personal endings are preserved only in the pronouns.

Words Derived from the Latin.—But the changes which the language underwent in the course of its transformation to modern English were, as has been seen, not wholly inflectional. A large number of new words were introduced, the most of them being from the Latin. As this foreign element is the most important, a few words may be devoted to its consideration. The words which came directly or indirectly from the Latin language are of three sorts: First, those which came through the Norman-French, and which are ours by inheritance from the Normans who 800 years ago made England their home, and who in the course of two centuries became fused with the English people; of which *castle*, *faith*, *spy*, *person*, *poor*, *custom*, *sermon*, *voice*, *place*, and *rage* are examples. Secondly, words of general use formed by scholars in later years directly from the Latin, or from some one of the Romanic languages, or which have been adopted without modification from those languages; examples of the first sort under this class being *index*, *consul*, *circus*, *opera*; of the second, *trait*, *chagrin*, *portmanteau*, *puisne*, or *puny*. Thirdly, words common to science in several languages, which have come into simple or metaphorical use in English by reason of the diffusion of knowledge and the immediate, everyday connection of science with the affairs of common life. Examples of this class are *zenith*, *diameter*, *tangent*, *ellipse*, *fulcrum*.

Growing Depth and Richness of English.—Any discussion of English which leaves out of account its increasing capacity to express subtle distinctions of thought and the whole range of emotion is necessarily incomplete. This power has largely resulted from the multiplication of metaphorical and other new senses of words, from the formation of new phrasal combinations upon the analogy of existing ones, from an imitation of such excellences of other tongues as could be conformed to English idiom, and, in general, from the greater flexibility imparted by thought to its chief instrument and medium. The history of these changes is the history of English literature, in which there is no considerable author who has not added something to the stores bequeathed him by his predecessors. To trace this progress, though in the barest outline, is beyond the scope of the present article, and for suggestions under this head the reader is referred to the subjoined bibliography and to the article on ENGLISH LITERATURE.

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English Literature: the written or printed expression of the thought of English-speaking races, wherever produced. The subject is divided according to historical periods, Old or Early English literature, comprising all prose and verse written before the Norman conquest of England, or, to speak with definiteness, from A. D. 450 to 1066, being classed as Anglo-Saxon. See ANGLO-SAXON LITERATURE.

MIDDLE ENGLISH.

The Norman conquest not only made a break in the natural growth of English speech, but brought in new intellectual influences and novel literary forms. The English language was displaced from many of its former uses. From 1066 to the middle of the fourteenth century the learned literature of the country was mostly in Latin and the polite literature in French. English did not cease to be a written tongue, but its extant remains down to the year 1200 are few and unimportant, if we except the continuation of the Anglo-Saxon Chronicle, which was carried on to 1154. After 1200 English came more and more into use in books, but mainly at first in translations and imitations from the French. The Normans were the most brilliant race of mediæval Europe, and their literature reflected their chivalrous, adventurous character, their passion for prowess and courtesy, their love of pleasure and magnificence. A people fond of exploits and devoted to deeds of knight-errantry naturally took delight in the narrative of such deeds. Chronicles in Latin prose, history mingled with fiction and put into Norman-French verse (*chansons de geste*), and fabulous tales of marvelous adventure (*romans d'aventures*) were their favorite reading. These metrical romances or chivalry stories were the most characteristic contribution of the Normans to English poetry. They were sung or recited by minstrels and wandering *jongleurs*, and numbers of them were turned into English verse during the thirteenth, fourteenth, and fifteenth centuries. Some of the earliest English romances were *Havelok the Dane*, *King Horn*, and *Sir Tristram*. The heroes of some of these romances were from national history or legend, as Richard Cœur de Lion, Guy of Warwick, and Bevis of Hampton. Others were of various times and places, as King Alexander, Sir Troilus of Troy, and Charlemagne. Still others were entirely fabulous, as in the romances of *William of Palerme*, *The King of Tarsus*, *Amis and Amiloun*, etc. The native alliterative verse was now generally abandoned for French meter and rhyme, the commonest form in the romances being the eight-syllabled couplet.

The favorite Anglo-Norman romance hero was that mythical Arthur of Britain whom Welsh legend had celebrated as the most formidable enemy of the Saxon invaders. Arthur had figured among other fabulous British kings in the *Historia Britonum*, a Latin pseudo-chronicle produced about 1135 by Geoffrey of Monmouth, a Benedictine monk, seemingly of Welsh descent. In 1155 the Norman Wace turned Geoffrey's history into French verse under the title

Geste des Bretons (afterward known as *Brut d'Engleterre*—i. e. Chronicle of England). About the year 1200 Wace's poem was translated into English by Layamon, a priest of Arley Regis, on the Severn. Layamon's *Brut* is in 30,000 lines, partly alliterative and partly rhymed. The style is rude but vigorous, and at times highly imaginative. The story of Arthur, however, received its fullest development in a series of French romances, composed partly in France and partly in England in the latter part of the twelfth century.

The English paraphrases and imitations of the French metrical chivalry tales are interesting for their illustrations of manners and ideals in the Middle Ages, but they have very little literary art. The French *trouvère* told his story in a straightforward, prosaic fashion, omitting no details in the action and unrolling endless descriptions of dresses, trappings, gardens, etc. His romance sometimes extended to thirty, forty, or fifty thousand lines. The English paraphrases had usually the prolixity of the originals, with greater rudeness of style and verse. The romances, however, abound in situations and characters, of which the poets of a more artistic though less inventive age have made a noble use—poets such as Tennyson, Swinburne, Matthew Arnold, and William Morris.

With the discontinuance of the Anglo-Saxon Chronicle English history written in English prose ceased for 300 years. The thread of the nation's story was kept up in Latin chronicles, compiled by writers partly of Norman and partly of English blood. The earliest of these, such as Ordericus Vitalis, Simeon of Durham, Henry of Huntingdon, and William of Malmesbury, were contemporary with the later entries of the Saxon Chronicle. The last of them, Matthew of Westminster, finished his work in 1273. About 1300 Robert, a monk of Gloucester, composed a chronicle in English verse, following in the main the authority of the Latin chronicles; and he was succeeded by other rhyming chroniclers, the most important of whom was Robert Mannyng, a priest of Brunne (now Bourn), in Lincolnshire, whose *History of England* was finished in 1338. In these chronicles the line between fact and fable was gradually obliterated, and the true history, of the Anglo-Saxon period especially, was overlaid with a mass of legendary material derived from such sources as Geoffrey of Monmouth's *Historia Britonum* and popular romances like *Guy of Warwick*.

Religious Literature.—Besides chronicles and romances there is a considerable body of religious literature, consisting of homilies in prose and verse, books of devotion, like the *Ancren Riwle* (Rule of Anchoresses), 1225, and *The Ayentite of Inwyt* (Remorse of Conscience), 1340, written in the Kentish dialect by Dan Michel, of Northgate, an Augustin monk at Canterbury. Both of these were in prose. In verse were Robert Mannyng's *Handling Synne* (1303); the *Cursor Mundi* (1320), a sacred history, intermixed with homiletic elements drawn from biblical, apocryphal, and legendary sources; and the *Prick of Conscience*, by Robert Rolle, a hermit of Hampole, in Yorkshire. There were also verse paraphrases of portions of the Bible, such as *The Ormulum*, or Book of Orm (1205), a version of the gospels for the day made by an Augustin monk named Orm in unrhymed metrical verse; the *Genesis* and *Exodus*, not much later, in rhyming couplets; and numerous renderings of the Creed, the Psalter, the Pater Noster, and the Commandments. There were also legends and miracles of saints. A particularly noteworthy collection of such was prepared toward the end of the thirteenth century at the great abbey of Gloucester. There were poems in praise of virginity; on the contempt of the world; on the five joys of the Virgin, the five wounds of Christ, the eleven pains of hell, the seven deadly sins, the fifteen tokens of the coming judgment; dialogues between the soul and the body; legends of the Holy Rood, of the childhood of Christ, of the Assumption of the Virgin; and prose allegories, such as the *Wohunge of Ure Laverde* (Wooing of Our Lord) and *Sawles Warde* (Soul's Ward). These were the work not only of the monks, but of the begging friars, and, in smaller part, of the parish priests. They are the literature of barbarism and superstition, instinct with the ascetic piety of the Middle Ages, with a childish belief in the marvelous, with the fear of hell, and with a profound sense of the misery of life, the quick coming of death and judgment, the vileness and corruption of the human body, and the wickedness of the human soul. Now and then a single poem rises above the general level of this monkish literature. Such is the poem known as the *Poema Morale*, composed perhaps as early as the middle of the twelfth century on the border of Dorset, Wilts, and Hampshire. This has a certain intensity of feeling and a personal note which distinguish it from other things of the kind, and it seems to have been widely influential in Middle English religious verse. Another poem similarly distinguished is *A Luve Ron* (A Love Counsel), of Thomas de Hales, a Franciscan friar of the reign of Henry III. This song, like many of the thirteenth and fourteenth century hymns to Christ and the Virgin, uses erotic imagery and language more appropriate to earthly passion than to divine love.* Three very noteworthy religious poems, *Clannesse* (Purity), *Pacience*, and *The Perle*, are attributed to an unknown poet who wrote about 1360 or 1370, and was therefore contemporary with Langland and Chaucer. The first of these poems illustrates its theme from the history of the deluge, of the destruction of Sodom, and of the fall of Belshazzar; the second from the story of Jonah. *The Perle* is a mystical poem of great beauty, describing a Dantesque vision in which a bereaved father sees his daughter among the glorified. *Clannesse* and *Pacience* are written in unrhymed alliterative verse, of which there was a revival shortly after the middle of the fourteenth century. One of the finest of the Old English romances, *Sir Gawayne and the Green Knight*, also attributed to the author of *The Perle*, is written in alliterative strophes of uneven length, each strophe closing with a few short rhyming lines.

Secular Poetry.—Among the few Middle English poems on secular subjects worthy of mention is *The Owl and the Nightingale*, generally assigned to the reign of Henry III. (1216–79), belonging to the class of pieces designated in Old French as *estrifs* or *disputoisons*. In this debate, which is conducted with some spirit and a free use of proverbial wisdom, the owl represents the ascetic and the nightingale the æsthetic view of life. In *The Flower and the Leaf*, a fifteenth century poem formerly attributed to Chaucer, this same conflict between utility and beauty is presented under other emblems, and with the machinery of court allegory which the *Roman de la Rose* had brought into fashion. *The Land of Cokaygne* is a piquant little thirteenth century poem of some two hundred lines, belonging to the species known in France as *fabliaux*, short, humorous, or satirical tales in verse. It describes a lubberland, or fool's paradise, where the geese fly down all roasted on the spit, bringing garlic in their bills for their own dressing, and where there is a nunnery upon a river of sweet milk and an abbey of white monks and gray, whose walls are of pastry, with cakes for the shingles and puddings for the pins.

A few songs dating from about 1300, and mostly found in a single collection (Harleian MS. 2,253), are among the very few English verses before Chaucer which have any lyrical art or any grace of diction or sweetness of modulation to a modern ear. These are written in French strophic forms, in the Southern dialect, and sometimes have an intermixture of French and Latin lines. They are fresh, simple, and often pretty. Some of them celebrate the coming of spring with its cuckoos and throstle-cocks, its daisies and woodruff.

> When the nightingalë sings the woodës waxen green,
> Leaf and grass and blossom spring in Averil I ween.

Others are love songs, and not unfrequently employ a burden or refrain, such as

> Blow, northern wind,
> Blow thou me my sweeting.
> Blow, northern wind, blow, blow, blow.

The oldest English song whose musical notes have been handed down with the text is the famous *Cuckoo Song*, dating seemingly from the middle of the thirteenth century, and beginning,

> Sumer is icumen in, lhude sing cuccu !
> Groweth sed and bloweth med and springth the wde nu.
> Sing cuccu !

Langland.—Standing between the old English and the new, uniting the form of the one to the spirit of the other, is the author of *Visio Willelmi de Petro le Plowman*, or *Piers Ploughman*, an anonymous work of which there is reason to believe that the author was William Langland, Longland, or Langley, a clerk or churchman of some grade, who was born at Cleobury Mortimer in Shropshire. *The*

* A number of such pieces are reprinted in Morris's *Old English Miscellany*, Wright's *Reliquiae Antiquae*, and the *Political, Religious, and Love Songs* in the publications of the Early English Text Society.

Vision of Piers Ploughman, to which some other writer afterward added *The Creed*, is a satirical poem written in alliterative verse. Together they form a national work, the first great original work in English literature. Neither the *Vision* nor the *Creed* has much coherence of plan, but the latter has more than the former. Langland was a humane satirist, and his purpose was to set forth the wrongs of his humbler countrymen, suffered at the hands of nobles and priests and lawyers, but chiefly at those of the priesthood. He gave voice to the sorrow, the shame, and the subdued indignation of a deceived, oppressed, and pillaged people. The tiller of the soil, from whose labors nearly all wealth springs, and who then, as often since, starved amid the food that he raised for others, found in him an advocate, and the grasping noble and the corrupt churchman a just judge and a pitiless satirist. The pathos and the humor of his work are not less remarkable than its causticity. It is in these respects, as in all others, thoroughly English in its tone and character; and as an exposition of popular feeling, and no less a picture of contemporary manners, it has not a superior in the whole range of literature. The following brief passages* are characteristic of the author's style and of his subject-matter:

And thanne cam Coveitise · kan I hym naght discryve,
So hungrily and holwe · sire Hervey hym loked.
He was bitel-browed · and babber-lipped also,
With two blered eighen · as a blynd hagge;
And as a lethern purs · lolled hise chekes
Wel sidder than his chyn · thei cheveled for elde;
And as a bondman of his bacon · his berd was bi-draveled,
With an hood on his heed · a lousy hat above
And in a tawny tabard · of twelve wynter age,
Al so torn and baudy · and ful of lys crepyng
But if that a lous couthe · han lopen the bettre,
She sholde noght han walked on that welthe · so was it thred-bare.
Vision, Passus v.

And as I wente by the way · wepynge for sorowe
I seigh a sely man me by · opon the plough hongen.
His cote was of a cloute · that cary was y-called;
His hod was ful of holes · and his heare oute
With his knoppede shon · clouted ful thykke;
His ton toteden out · as he the lond tredede;
His hosen over-hongen his hok-shynes · on everiche a syde
Al beslomered in fen · as he the plow folowed.
Tweye myteynes as meter · maad al of cloutes,
The fyngres weren for-werd · and ful of fen honged
This wit waseled in the feen · almost to the ancle
Foure sotheren hym byforne · that feble were worthi:
Men mighte reknen ich a ryb · so senful they weren.
His wiif walked hym with · with a long gode,
In a cuttede cote · cutted ful heyghe,
Wrapped in a wynwe shete · to weren her fro wederes
Bar-fot on the bare iis · that the blod folwede.
And at the londes ende lyth · a little crom-bolle,
And thereon lay a lytel chylde · lapped in cloutes
And tweyne of tweie yeres olde · opon another syde
And al they songen o songe · that sorwe was to heren;
They crieden alle o cry · a kareful note
The sely man sighed sore · and seyde, Children, beth stille.
The Creed, etc.

It is worthy of remark that the first great work in English literature was written in a language formed neither by scholars nor courtiers, but by the people at large, and that it was a protest against wrong, against fraud, against priestcraft and hypocrisy—a demand for the recognition of human rights, for personal freedom and liberty of conscience.

Wycliffe.—The *Vision* and the *Creed* of Piers Ploughman bear the stamp of a great historical period. At the time of their production John Wycliffe and his followers were disturbing the established religion of England at its very foundations, and the author or authors of *Piers Ploughman*, if not openly attached to the Lollard party, must be reckoned as of it. As regards the *Creed*, this fact was recognized in the most emphatic manner by the ministers of the prevailing religion, for they caused the copies of it to be so thoroughly destroyed that, whereas the old manuscripts of the *Vision* are many, of the *Creed* not one is known to exist. *Piers Ploughman*, itself equally valuable as a record of the condition of language and religion, was thus one of the writings that ushered in that great work, itself equally important as to religion and language, the Wycliffite translation of the Bible. This was made from the Latin Vulgate by Wycliffe and some of his followers about 1380. No other single work ever exercised so much influence upon the political, moral, literary, and linguistic future of a people as the Wycliffite Bible did, except, perhaps, Luther's translation of the same Scriptures into High German nearly 200 years afterward. It was the beginning of a revolution which freed Englishmen from the rule of a foreign hierarchy, and ended in the deposition of the Stuarts and in the Bill of Rights. Although it added little to the English vocabulary, it enriched English expression—we might almost say English idiom—with a strong and peculiar phraseology which sprang from the contact between Hebraic thought and English speech, and which, having been preserved through 300 years, even to the revised translation of 1611, and having been read and listened to and taken to heart by so many generations of Englishmen, came to affect in a measure the whole popular cast of thought and of speech. It was the Wycliffite version that did this; for although there was, as has been seen, an Old English version of the Bible, this did not spread among the English people; and being almost forgotten and quite incomprehensible to the English people at the middle of the fourteenth century, there was no such connection between it and the Wycliffite version as there was between the latter and the received translation; in fact, there was no connection at all. This translation, completed about 1380, was revised by John Purvey, a learned Wycliffite writer who had made the subject of translation a profound study, and who sought to render this version more exact and more conformed to English idiom, which end he attained with admirable skill, finishing his work about 1390. Apart from the peculiar Anglo-Hebraic phraseology before mentioned, this translation tended to modernize the language. It was, as to simplicity of forms of words and the untrammelled construction of the sentence, in advance of the general English writing of its day; and its unparalleled literary influence led to the confirmation of this freedom from grammatical restraint among all English people, particularly those of the middle and lower classes.

Chaucer.—Geoffrey Chaucer was a younger contemporary of the author or authors of *Piers Ploughman*, as he was born about 1340, and died about 1400. He was connected with the court, having married the sister-in-law of John of Gaunt, the father of Henry IV. He was pensioned, employed in diplomacy, and made comptroller of the customs. As Langland's poems were addressed to the middle and lower classes, and written in their interest, so Chaucer wrote for the nobles and gentry; and the tone of his poems was suited to the temper of his audience.

Chaucer was a voluminous writer, but his chief works are *The Canterbury Tales*, *Troilus and Creseide*, and *The Romaunt of the Rose*. Of these the *Canterbury Tales* are the most original and the most characteristic of his genius, although *Troilus and Creseide* is as fine a narrative poem, not of the heroic cast, as exists in any literature. Chaucer is essentially a narrative poet. He is the earliest poet since the revival of literature after the Dark Ages who has awakened an enduring sympathy in the characters and the feelings and the fate of his personages. He is the first, indeed, who portrays real individuality of character. Each one of the personages in the pilgrimage to Canterbury, which is the occasion of the *Tales*, exists to this day in the minds of his readers as a living character that has as real and independent a being as any creature of flesh and blood that is met in one's daily life. In this respect he is a rival of Scott (in his novels), and almost of Shakspeare. Like the former, he paints them; like the latter, he makes them unconsciously paint themselves. He is English in all the traits of his mind and his style; and in nothing more so than in his humor. So early (also in *Piers Ploughman*) did this peculiar trait of English literature, in which it is unrivalled by that of any other people, appear, and with all its inexpressible and humanizing charms in fullest bloom and subtlest fragrance. As an historical picture of the time in which they were written, the *Canterbury Tales* are as if the veil of five centuries were lifted and we looked in upon a gathering of our forefathers in the free enjoyment of each other's society. But above all Chaucer's other charms is that of his strong and clear imagination. What he described he saw in his mind's eye as clearly as if it appeared before him in the body. We see with him the very personal traits and tricks of the people that he sets before us, no less

* As these passages are quoted for their matter, and not for their language, I have chosen the text edited by Wright, and with him have modernized the þ and the ȝ, in preference to following the more accurate but less generally readable text of Skeat.

than the adventures through which they pass or which they relate. There is all the freshest charm of nature in him, joined with the elegance of an accomplished man of the world. So in his language there lingers some of the homely roughness of early English, while at the same time it is strongly marked with the dainty splendor of the speech that, like some other pretenders, came over with the Conqueror. Chaucer stands alone, not only in his merits but in his literary position. He had no fellows; few contemporaries worth mentioning; and after his period a darkness fell upon English literature, through which glimmered a few dim and struggling lights whose only function was to make darkness visible.

Gower.—John Gower, a barrister (b. about 1325; d. 1408), was the chief of Chaucer's contemporaries. His reputation was great. Chaucer himself speaks of him with deference, and calls him the "moral Gower." But the dull, dead weight of his style has sunk him out of sight, and left only his name floating upon oblivion. His *Confessio Amantis* (Confession of the Lover) is a long nondescript poem, to read which requires the patient, self-sacrificing courage of a conscientious investigator of the history of our older literature. It has little claim to attention even as a contemporary record of manners and morals.

Barbour.—Of all the poets of Chaucer's day, John Barbour was the only one worthy even of comparison with him. Barbour (b. about 1316; d. 1395) was, according to the political division of the country, a Scotchman. But political divisions have nothing to do with literature or with language, and Barbour merely wrote in Northern English as Chaucer wrote in Southern. Barbour and his neighbors rightly called their language English, and so it continued to be called until toward the end of the sixteenth century, when local pride and political jealousy caused it to be called Scotch—a change of designation which has been the cause of much misapprehension and confusion. Nothing more truly English in speech or in spirit was ever written than this passage from Barbour's principal work—a long epic, or at least historical narrative poem, *The Bruce*:

> Ah! fredome is a noble thing
> Fredome mayss man to haiff liking
> Fredome all solace to man giffis
> He levys at ess that frely levys.
> A noble hart may haiff nane ess,
> Na ellys nocht that may him pless,
> Gyff fredome failyhe: for fre liking
> Is yharnyt our all othir thyng.
> Na he that ay hass levyt fre
> May nocht knaw well the propyrte,
> The anger na the wretchyt dome
> That is cowplyt to foule thyrldome.
> But gyff he had assayit it
> That all perquer he suld it wyt;
> And suld think fredome mar to pryss
> Than all the gold in warld that is.
>
> *Book I.*, ll. 225–240.

No less remarkable than the sudden uprising of such a poet as Chaucer, and one may even say of Barbour, is the fact that within their century there appeared no writers of either poetry or prose who were worthy of being called their followers, and that for nearly 200 years after the death of Chaucer the standard of literature was low. For this there were two reasons that can now be seen—perhaps others hidden by the distance of time. The first is the violent repression of all free thought which was brought about by the efforts of the Church to crush Lollardism and extinguish the very embers and sparks of the fire kindled by the Wycliffites; next the desolating civil War of the Roses, which broke out in 1455, and afflicted England with its consequences for quite half a century, although the war itself lasted but thirty years. Of the anti-Wycliffite writers the most eminent was Bishop Pecocke, who had some vivacity of style if no strength of thought. The most remarkable prose book of the latter part of the fifteenth century is the *Morte d'Arthur* of Sir Thomas Mallory (b. about 1430), compiled and translated from the French about 1470—a work which in its animation, and sometimes its simplicity and tenderness of style, does something to relieve the literary barrenness of its century. Mallory's language is remarkable for its freedom from Romanic words, to which fact it owes much of its directness and its strength.

Caxton.—At this period printing was introduced into England by William Caxton, who in 1474 printed his first book, a *History of Troy*, translated from the French. Caxton was a translator and an adapter as well as a printer, but not even his wonderful mechanical art had at first much influence upon either literature or language. Of poets, or writers of rhyming verse, in this period we have Occleve (about 1370–1454) and Lydgate (about 1370–1450), whose names only need be mentioned in a sketch like this.

It was in the North that the best literary work was done at this period, although Andrew of Wyntoun, a clerical chronicler in verse who flourished about the beginning of the fifteenth century, is little more than a rude rhymester, the value of whose work is chiefly historical. But James I. of Scotland, in his *King's Quair*, shows fancy, fine conceit, and the fruit of a careful study of Chaucer, whose works soon began to exercise a great influence upon poetical literature. Robert Henryson (or Henderson) not only studied and imitated him, but also wrote a continuation of *Troilus and Creseide*, which he called *The Testament of Fair Creseide*, which has been with some reason deemed not unworthy of being printed in company with Chaucer's poem. Of all the extreme Northern English poets, Henryson and James I. show most the influence of the Southern language and literature. Henryson, who lived until about 1500, is the author of other poems of merit, among them the beautiful pastoral *Robin and Makeyne*, which was reprinted in the Percy Collection. A poet known as Henry the Minstrel, or Blind Harry, composed a long poem of which the life of William Wallace was the theme. It is a genuine strong piece of poetical "making," quite Homeric in a rude and humble way, and full of hatred of "the Saxon"; Blind Harry himself being probably as good a Saxon or "Anglo-Saxon" as there was to be found south of the Tweed. After this period the so-called Scots literature shows a wider divergence in spirit and in form from that of the South, or of England proper.

MODERN ENGLISH.

More.—The first part of the sixteenth century produced in Sir Thomas More (1478–1535), King Henry VIII.'s second lord chancellor, the first English prose-writer of merit after Chaucer, whose prose was, like his poetry, the best of its kind that England saw for more than a century. More was a man of learning for his time, wise, humorous, penetrative, and of noble impulse and purpose. He wrote many controversial works of timely interest, and in Latin his famous *Utopia*. Of his English writings the most important is his *Life and Reign of Edward V.* (called his *Life of Richard III.*). In this his narrative power and his characterization of the personages whom he sets before us give him a conspicuous as well as an early place in the true historical English literature. His writings were produced between about 1515 and 1535, when he was beheaded. About the same time Sir Thomas Elyot (b. before 1490; d. 1546) wrote his political work, *The Governour*.

Tyndale.—It was theology, however, which gave new life to English literature, upon which William Tyndale and his followers conferred a benefit only inferior in degree to that which they bestowed upon the cause of freedom of conscience and purity of religion. Tyndale (b. about 1484; burnt at the stake 1536) made the first translations of parts of the Bible into English from the original Hebrew and Greek. But although he went to the original tongues, he did not lay aside the Wycliffite version, but on the contrary he kept it in mind, if not before his eye, and seems to have endeavored to preserve its phraseology as far as was consistent with a faithful rendering of the original text and a necessary conformity to the general speech of his own day. To this endeavor is due the continued life of that grand, strong, simple phraseology which English-speaking men recognize at once as "the language of the Bible," and which has for more than 450 years exercised an elevating and purifying influence upon the English language and literature. Tyndale's translation is the most important literary and philological fact between the time of Chaucer and that known as the Elizabethan period. Tyndale was also a voluminous writer in commentary and controversy, and a stout and a successful disputant with Sir Thomas More. His English, like his thought, is notably vigorous, manly, and clear, and he with his followers—among whom John Frith (b. about 1503), a Kentishman, was conspicuous—were the salt of English literature in the first part of the sixteenth century. These men wrote in a simpler, homelier style, and in more nearly unmixed English words, than any writers after the beginning of the third quarter of their century. Archbishop Cranmer (1489–1556), and notably Bishop Latimer (b. about 1485; d. 1555), were in their sermons and controversial writings apostles of simple English as well as of gospel truth. Latimer preached to the common people in their daily speech and with the most unstudied homeliness of diction and illustration. About this time there was an effort at English purism. Sir John Cheke (1514–57), one of the few Greek scholars in England, began a translation of the New Testament, in which, as in his other writings, he was studious to represent Greek words by English equivalents, and went so far as to coin such words as *fore-shewers* for prophets, *hundreders* for centurions, and *again-birth* for regeneration.

Ascham.—Cheke's friend Roger Ascham (1515–68) wrote his *Toxophilus* less to teach his countrymen how to draw the bow, which they had drawn pretty well at Hastings, than to show them an example of a pure, idiomatic, and elegant English style, which he did most effectually. In this effort he was seconded by Thomas Wilson (d. 1581) in his *Arte of Rhetoricke* (1553), and thirty years later by George Puttenham in his *Arte of English Poesy.*

The Northern poet, Gawin Douglas (b. about 1474), deserves a passing notice for his translation of the *Æneid*, said to be the first version of that classic published in Britain. Next come the poets and prose-writers who were to usher in the brightest period of the world's literature since that outburst of Greek genius which took place in the age of Pericles.

Skelton.—John Skelton, Lord Surrey, and Sir Thomas Wyat (1503–42) were almost contemporary poets, but the first was singularly unlike the last two. Skelton (b. about 1460; d. 1529) was the more learned, and in his day had the greater reputation, Erasmus having styled him the light and ornament of English letters. But Erasmus doubtless had in mind only his Latin verses, which are esteemed by scholars as remarkably pure; for anything written in a "vulgar"—i. e. a living—tongue was even then regarded as much unworthy the consideration of such a scholar as Erasmus. Skelton's English poetry is fantastic, extravagant, sometimes so incoherent as to be almost incomprehensible, and often so coarse as to be repulsive. But he introduced liveliness of movement and freedom of versification, much needed in English poetical literature, and with all his coarseness he was not without brightness of fancy and grace of expression. His *Philip Sparrow*, a poem of nearly 1,400 lines, has many passages distinguished in these respects.

Wyat.—Sir Thomas Wyat, a traveler, courtier, satirist, and writer of lyric poetry, was born in 1503. He and Lord Surrey (Henry Howard, b. about 1516)—who translated part of the *Æneid*, introduced blank verse into English poetry, and first wrote English sonnets—were the first true refiners of modern English style. They became the models of grace and elegance to their contemporaries and immediate successors. They died within a short time of each other, the former in 1542, the latter, on the block, in 1547. Wyat's poems were published in 1557.

Thomas Tusser (1527–80) wrote *A Hundred Points of Good Husbandrie*, but his verses have value only as bucolical antiquities; George Gascoigne, a dramatist, satirist, and critic of merit, who was one of the earliest English writers of blank verse (d. 1577); and Thomas Sackville, Earl of Dorset (1527–1608), the author with Thomas Norton, of the first regular English tragedy, *Gorboduc, or Ferrex and Porrex*, which was also written in blank verse. But more than a passing notice must be taken of Sir Walter Raleigh (1552–1618), whose bright intellect, daring spirit, and checkered life make him one of the most conspicuous figures in English history and literature. He was praised by Spenser, and his praise added to Spenser's glory. His poetry is remarkable for manly simplicity and freshness of feeling, mingled with sententiousness; his political writing for sagacity and knowledge of mankind; and his *History of the World* is full of wisdom, and closes with one of the grandest passages in English prose.

Sidney.—Somewhat like Raleigh in the circumstances of his life, although not in the character of his mind, was Sir Philip Sidney (1554–86). A younger scion of a noble family, he too was a soldier, a courtier, a scholar, and a poet. According to all accounts, he was the most accomplished, the most admirable, and the most lovable among English gentlemen of his day. He was a patron of literature as well as a man of letters. His claim to notice as an author in the history of English literature rests upon his *Arcadia*, a collection of romantic and chivalric tales bound together with a slender thread of plan, somewhat extended and wearisome, but full of graceful and animated passages; some poems, generally cold and deceitful, but in a few instances lofty in tone and lovely in imagery; but chiefly upon his *Apologie for Poetry*, the earliest example of æsthetic criticism in English literature, and admirable for the beauty of its style and the soundness of its critical judgments, few of which have been set aside or superseded.

Spenser.—Sidney probably deserves the credit of having made possible the poetical career of one of England's greatest poets, Edmund Spenser. Spenser, born about 1552, after having written *The Shepherd's Calendar*, it is supposed at Penshurst, the seat of the Sidneys, where his friend Sir Philip took him to reside for some years, received a grant of 3,000 acres of crown land in Ireland, whither he went and where he wrote the first three books of his *Fairie Queen*, when, going to London to have them printed, Raleigh presented him to Queen Elizabeth, who, in consideration of his poem, gave him, in addition to his lands, a pension of £50, quite equal to $1.500 now. There and then he wrote, among other poems, *Mother Hubbard's Tale.* Returning to Ireland in 1592 he wrote two more books and two cantos of a third of his great poem; his series of eighty-eight sonnets, *Amoretti*, celebrating his courtship of the lady whom he married; his *Epithalamion* on his marriage; *Colin Clout's Come Home Again, Astrophel*, and other poems. He returned to London in 1598, and died there in 1599. If not the greatest of the poets of the Elizabethan period (which may be regarded as including the half century from 1575 to 1625), Spenser was second to one only, and he was the greatest of all those who lived entirely in Elizabeth's reign. Among all English poets he has but two superiors—Shakspeare and Milton—although it is only in the elevation of his aim and in the fine and luminous flame of his fancy that he surpasses Chaucer. Spenser is the most purely poetical of all English poets. His great work, *The Fairie Queen*, is poetry, and nothing else. It is not dramatic, or theological, or satirical, or, strictly speaking, narrative; and although it did fashion "the twelve moral Virtues," it is not didactic after the weary fashion of most moral poems. It is allegorical, but its peculiar merit is not in the allegory; rather is the allegory somewhat of a hindrance to the reader who is not capable of setting the didactic purpose of the poem aside and enjoying for itself the golden wealth of its rich fancy. The language employed was somewhat old-fashioned for Spenser's own day. He used words that were not then familiar household words, and forms and inflections that had passed away—for instance, the old plural in *en.*

Among the Elizabethan writers a theologian like Richard Hooker (about 1553–1600) must at least be mentioned. His sagacity and the logical clearness of his thought gained him the title of "the judicious," and his style places him high among the masters of English prose.

Lyly.—The writings of John Lyly (about 1554–1606) mark a change in the character of that prose. He introduced an almost fantastical style of writing. He affected fine phrases, and wrote for courtiers and those who would have finer bread than is made of wheat. The title, *The Euphuist* (one who speaks well), is derived from his principal work, *Euphues and his England*, which had much influence, and even brought about a style of speech and writing called euphuism. But it would be very wrong to assume that this work is a mass of fanciful folly in affected language. The book is full of good sense and knowledge of the world. He also wrote six court comedies, which have little genuine dramatic interest, but which are very elegant and highly finished productions of their kind.

Fulke Greville, Lord Brooke (1554–1628), "friend to Sir Philip Sidney," a poet, dramatist, and critical writer, whose style is cumbrous, but whose thought is far-reaching and weighty, can only be thus mentioned.

In the galaxy of poets that lighted up the Elizabethan sky even a merely superficial glance distinguishes William Warner (b. about 1558; d. 1609), Samuel Daniel (1562–1619), Michael Drayton (1563–1631), Bishop Joseph Hall (1574–1656), Joshua Sylvester (1563–1618), and George Chapman (1557–1634), the first translator of the whole of Homer's poems into English, and whose version, often inexact and rude, has an occasional sinewy strength and pithiness and a felicity of phrase which his more polished and scholarly successors have not attained. Chapman was also a dramatist, but his dramatic work, although always indicative of poetic ability, was loose in structure and in style confused and headlong.

Marlowe.—Next comes the consideration of that remarkable school of writers, the Elizabethan dramatists proper. At this period the theater was the chief intellectual entertainment of all classes and conditions of men, from the highest to the lowest. It filled the place now occupied by the novel and the newspaper. Young men of literary ability who found themselves in need of money in London turned to the stage as a means of supplying their necessities. The proprietors of the theaters kept poets in their pay, and ordered plays to be written sometimes by one, sometimes by two, and sometimes by half a dozen of their retainers. Conspicuous among these dramatic adventurers was Christopher or "Kit" Marlowe, a man of genius, but of genius wild, irregular, ill-trained. Both mind and man (if a man may be separated from his mind) lacked moral balance. The fierce extravagance and gilded bombast of his style can hardly be overrated; but from this turbid mass flash out gleams of brightest poetry. His characterization is often so strong as to be mere caricature, but it *is* characterization; his personages have individuality; and he first introduced the modern style of dramatic writing. To him also is due the introduction of free and flowing blank verse upon the stage. His principal dramas are *Faustus*, *Tamburlaine the Great*, and *Edward II.* Born about 1564, after a life of wretched irregularity he was killed in a brawl, 1593. Co-laborers with Marlowe were George Peele (about 1552–98) and Robert Greene (about 1560–92), men of much lighter weight and smaller caliber; the former an agreeable versifier and capable of tenderness; the latter essentially comic in the bent of his genius, giving foretaste both of the high and the low comedy of after years. With these men there was a crowd of others who have left names, and even works, known to literary antiquarians, but long ago forgotten in literature and on the stage; but from among them sprang one in all supreme—the greatest poet, the greatest dramatist, the brightest intellect of recorded time.

Shakspeare.—William Shakspeare, of English or "Anglo-Saxon" blood (b. 1564), when about twenty-one years of age went to London as an adventurer; became a player and a playwright; obtained an interest in the company which played at the Blackfriars and the Globe theaters, and by the plays which he wrote for this company—writing them as daily labor, just as a journalist nowadays writes leading articles and criticisms—he made himself "the greatest name in all literature." To attempt here a criticism upon Shakspeare's genius would be futile. Briefly, it may be said that he owed nothing either to his predecessors or to his contemporaries, if we except the language in which he wrote and the form of his dramas, which were those of his time. He attempted nothing new; he simply was new himself—the most original, inexplicable, and hitherto absolutely unexplained fact in the history of literature. He seemed to know the secrets of nature and of man's heart, and to penetrate the depths of wisdom and of philosophy by intuition. He was a creator of his kind, for at a touch of his pen he spoke men and women into an existence individual and immortal. His style can hardly be described, it can not be analyzed, and it has never been imitated. And there was no limit to the capacity of his genius. He sounded man's nature and the range of human thought from the top to the bottom of its compass. The grandest and the profoundest of all writers, he was at the same time not only the most delicate and the most fanciful, but the most comic. There is no tragedy, no philosophy, no pathos, no fancy, no humor like Shakspeare's tragedy, Shakspeare's philosophy, Shakspeare's pathos, Shakspeare's fancy, and Shakspeare's humor. All is said that can be said when they are called Shakspearian. To mention the titles of his principal dramas is quite needless. All the world knows that *Hamlet*, *King Lear*, *Othello*, and *Macbeth* are his greatest tragedies, but it may well be said that his wisest play is one never played now and too little read—*Troilus and Cressida*. He wrote at first in conjunction with other playwrights, after the manner of his time, but his facility in composition soon freed him almost altogether from the trammels of collaboration, and nearly all the great comedies, histories, and tragedies that bear his name are of his own unaided production. His sonnets are inferior in thought and in expression only to his best plays. They alone would have won him immortality. His most inferior works are those upon which he labored most and rested the only literary fame he coveted—his poems *Venus and Adonis* and *Lucrece*. He attained his purpose and retired to Stratford in the prime of life, a prosperous gentleman; and there he died in 1616, entirely regardless of his poetic fame, having no predecessors or successors except in the order of time. None of his contemporaries were like him. There was an Elizabethan period of poetry and of the drama, but no Shakspearian school of either.

Jonson.—Chief among Shakspeare's contemporaries was his friend Ben Jonson (b. about 1573; d. 1637), who for some time was regarded by the critical, but never by the public, as his superior. But gifted as Jonson was, the difference between them is absolutely immeasurable. Jonson's best comic work, as in *Every Man in his Humor*, *The Alchemist*, and *Bartholomew Fair*, is simply a humorous—and yet not very humorous—picture of what passed before his eyes—persons and manners. His tragedy is an unsuccessful attempt at the imitation of classic models. In some of his tragedies, founded on classic subjects—e. g. *Sejanus*—no inconsiderable part of the speeches are translations, more or less free, from Latin authors. He was overlaid with his learning. He was nevertheless a robust thinker, and at times a graceful one. Some of his minor poems, particularly his songs, have a peculiar charm which makes them the best known of all his works. He wrote one of the earliest English grammars, and in his *Timber* some of the earliest literary criticism in the English language.

Beaumont and Fletcher.—Francis Beaumont (1584–1616) and John Fletcher (1579–1625), wrote together, although there are many plays by Fletcher alone. They were poets, wits, and dramatists, but not of a very high order, although of the high imaginative school. Comedy was their forte, and they first brought upon the English stage the comedy of intrigue. Their works are very voluminous, and suffer from a diffusion of powers by no means exhaustless. If they had written less they would have written better. Their most meritorious works are *The Maid's Tragedy*, *The Elder Brother*, *Philaster*, and *The Faithful Shepherdess*, the last of which was written by Fletcher alone, who had more fertility, more constructive power, and a livelier fancy than Beaumont.

Among the second-rate men of this period whose names only can be mentioned here were Philip Massinger (1584–1640), who had tragic powers, but who was destitute of fancy and humor; John Ford (1586–about 1639), whose forte was pathos; John Webster and John Marston (b. about 1575; d. 1634), who dealt in the tragedy of horrors; Thomas Dekker (b. about 1570), who had in a marked degree both pathos and humor, but whose wretched life gave him little opportunity to finish his work; Thomas Middleton (b. about 1570, d. 1627), a man of pleasing mediocrity; and Thomas Heywood, the most voluminous of them all, that being his chief distinction. James Shirley (1596–1666) closes the array of Elizabethan dramatists, and is the link between the times of Elizabeth and James and those of Charles and the Commonwealth.

Bacon.—Among the great intellects of the Elizabethan era only one man—and it might almost be said hardly he—is more conspicuous than Francis Bacon (1561–1626). His misnomer is a notable recognition of his greatness. He became Lord High Chancellor and a peer, his title being Lord Verulam, but the man was far above his peerage, and is called Lord Bacon. His distinction was in this, that he was the wisest man of modern times, almost the wisest of the sons of men. To no man since the revival of learning may the term "philosopher" be so well applied. As a scientific investigator he has had many superiors; his scheme of inductive philosophy may not be original; but if he had not written the *Novum Organum* he would yet have taken the stand which he has held for two centuries, adown which from his sun-like mind has poured a blaze of intellectual light; for he had the grandeur and the poise and the far-reaching power which make a central luminary, and whatever he uttered bore the stamp of his supremacy. To English literature, strictly speaking, his contributions were not large, for the most of his writings were in Latin. His *Essays*, by which he is chiefly known to general readers, were written in English, and they alone would have made his name immortal. Such a solid body of clear, compact wisdom was never uttered to the world from an uninspired source before his day or since. They show in every page the largeness, the breadth, and depth of his great intellect. In style they are models of concentration, giving results, not processes, and yet revealing the foundations of eternal truth upon which their judgments stand. It is worthy of remark that there is no evidence in the writings of either that he and Shakspeare, the two brightest intellects of modern times, strictly contemporaries and living in the same place, knew of each other's existence; the reason of which strange fact is that one was a statesman and a philosopher, the other a player and a playwright.

Burton.—In the reign of James, Robert Burton (1577–1640) produced the *Anatomy of Melancholy*, a compound of curious learning, made piquant by the spice of splenetic humor and jocular sneers with which the quoted passages are seasoned to bring out their flavor. It is so filled with Latin that it is hardly an English book, but it is a typical specimen of a school or fashion of learned writing which prevailed about this time; and notwithstanding its pedantic air it has been, and ever will be, a source of delight and a quarry of suggestion to a large class of highly cultivated readers, and greatly so to those who themselves are writers. The names of Donne (1573–1631), a metaphysical poet; of Sir Thomas Overbury (1581–1613), the author of *The Wife*; of Richard Sibbes (1577–1635), a Puritan divine; of John Hales (1584–1656), a theologian and the author of *Golden Remaines*; and of William Drummond of Hawthornden (1585–1649), a Scotch poet of merit and a historian of Scotland—must be mentioned in an attempt to give a view of English literature at this period.

A notably important fact in regard to the Elizabethan era in literature is that the English language, which was fully formed at the beginning of the sixteenth century, was used in that era with a freedom from formal restraint that since then has been unknown. The parts of speech changed places at the will of the writer. Not only were adverbs used as adjectives, and adjectives as adverbs, but adverbs as nouns, and not only nouns, but even pronouns were used as verbs. A like freedom reigned as to other parts of speech and in the construction of the sentence. Thus was born, in full strength and activity, the genius of the English language, which is that the nature and quality of a word depend not upon its form, but upon its place in the sentence and its logical relation to other words. Thus the English of the Elizabethan period was more truly and absolutely English than that of any period before or since. This freedom prevailed most remarkably in the writings of the poets and the dramatists of the period, and chiefest of all the latter. But it pervaded all writing and all speech. That it was prevented from degenerating into chaotic license is probably due in a large measure to the preparation and diffusion of the revised or King James's translation of the Bible, which was published in 1611.

King James's Translation of the Bible.—In this translation, made with extremest care and the interchanged labor of forty-seven of the most competent scholars in England, the language of the previous versions was not only kept in view, but retained whenever it was consistent with the original, and sufficiently modern to be comprehensible without losing the dignity which pertains to antiquity, or taking on the strangeness which goes with novelty. The translators touched the sacred old structure with reverent hands, and while they renovated and strengthened it they did not whitewash the mellow tints of time with glaring newness. This book was at once published abroad throughout England, and since that time it has been printed and reprinted and scattered, and read daily by people of English race as no other book was ever read by any other people. Its influence upon English literature has been as great as upon the morality of English life. It has been the treasure-house and the stronghold of the English language. It contains the best, the purest, the manliest, and the sweetest English that was ever written. Its narrative style is beyond that of all other writing in its own or in other tongues for simplicity, for clearness, and for strength. No exhortation is like its exhortation, and no other counsel comes clothed in such impressive dignity of phrase. In it the rich and glowing diction of its Oriental original is preserved, and yet tempered with something of the cool directness, the honesty, and the homely freshness of the Anglo-Saxon nature. Its influence upon the English language has been the most pervading and the most wholesomely conservative that was ever exercised by a single force. Its authority has surpassed that of any possible academy.

After the death of Bacon and of James I. a few names of note attract attention before the period of the Commonwealth is reached: George Wither (1588–1667), a poet chiefly sacred, nervous in style, and remarkable for his simple, clear English; Thomas Hobbes (1588–1679), who wrote upon social and moral subjects and translated Homer into halting verse —a strong, clear, but not always logical thinker, and the first English master of regularity and symmetry of style; Thomas Carew (d. about 1639), a tender and graceful writer of light amatory verse, which, based upon French models, has the merit of character; Robert Herrick (1591–1674), who, writing both sacred and amatory verse, is known chiefly by the latter, in which he clothes his exquisite conceits in a rich style; Isaac Walton (1593–1683), a meek and pious angler, who wrote *The Complete Angler* and the lives of Donne, Hooker, and other divines, and whose love of nature and simple pedestrianism of life and style win him admirers generation after generation; George Herbert (1593–1633), whose collection of short poems called *The Temple* had an amazing popular favor, 20,000 copies having been sold, according to his biographer Walton, in a few years. Herbert belongs to the metaphysical school of Donne. His thoughts are almost a continued succession of quaint conceits and are steeped in ecclesiasticism; but they are pervaded with the spirit of true piety and uttered in English notably simple and manly.

Waller.—To the time of the Commonwealth and the Restoration belongs Edmund Waller, who was born in 1605, and who devoted himself to politics and to literature. His verse unites grace and dignity, although he is sometimes tempted into extravagance. His lines *On a Girdle* express one of the most exquisite amatory fancies in love-literature. He had a charming fancy, but little imagination. Contemporary with him were Thomas Randolph (1605–34), whose poems are tame, but in whose plays there linger echoes of the Elizabethan grandeur and freedom; Sir William Davenant, playwright and poet-laureate, but a poor creature; Sir John Suckling (1609–42), a dainty poet and an amorous; and the gallant Richard Lovelace (b. 1618; d. 1658), whose songs give the soul of chivalry and true love voice.

Milton.—All the poets of this period were eclipsed by the grand and luminous shadow of John Milton (1608–74). His prose works, chiefly controversial, and chiefly inspired by the great civil war, need not be noticed, except by name. Their value was chiefly for their time, and neither in them nor in any other of his prose works did his genius show, except fitfully, its peculiar power. Indeed, his prose, although strong in thought, is in style involved, cumbrous, and awkward. Of these the ablest are *Eikonoklastes, A Defence of the People of England, Tetrachordon, The Doctrine and Discipline of Divorce, The Tenure of Kings and Magistrates, A Tractate of Education*, and *Areopagitica, a Plea for the Liberty of Unlicensed Printing.* But it is as a poet that Milton lives in the world's memory, and of modern epic poets he is incomparably the greatest. His earlier and minor works have a serene and lofty grace of expression, united with a sustained power, that preludes the coming epos. But their merits, great as they are, are less imaginative than fanciful, although the fancy is of the very highest order. *L'Allegro* shows that he could even be playful. His sonnets have been much praised, particularly since Wordsworth said of him that in his hand the sonnet "became a trumpet." His powers were better displayed in his great epic poem, *Paradise Lost*, which has the singular advantage of the grandest theme, the theme most interesting to all Christendom, and the most suggestive of sublime thought, that could have been chosen. The style of the *Paradise Lost* in its finest and most characteristic passages has an almost indescribable grandeur and strength. Its lines are adorned with a wealth of illustration compelled from all literature and all history, sacred and profane; and its author marches along his royal road of verse like some great conqueror whose triumph is made splendid with the spoils of subject peoples. But these are the mere tokens and decorations of his own power. His thought and his purpose are always supreme. In the *Paradise Lost* and the *Paradise Regained* the poet worked out to the utmost bound of possibility mere hints in the sacred writings of the Hebrews and the Christians, and thus became the originator of many of the popular views of theology since his day. Milton is not, properly speaking, an English poet, or an English prose-writer. His style and the very character of his thought are eminently un-English. His spirit is Hebraic, his form that of Latin and Greek models. His last work, and one of his greatest, *Samson Agonistes*, is remarkable in this respect. In its form it is modeled upon Æschylus; its spirit is caught from Joshua, from Ezekiel, and from Isaiah. In one remarkable respect Milton is eminently un-English: he is entirely without humor, that peculiarly English, or at least

Teutonic, quality of mind which manifests itself in some degree in almost every other eminent writer of that race. Milton, celebrated as a controversial writer and a scholar almost from his youth, did not achieve fame as a poet during his life-time. The *Paradise Lost* was not appreciated highly, not to say at its full worth, until after a series of criticisms by Addison in the *Spectator*, and *Comus* and his other minor poems were first brought into general notice by Pope and Warburton. Milton, great as he was, does not stand in the front rank of poets—that is occupied by but three men, Homer, Dante, and Shakspeare—but first in the second rank without a doubt is the author of the *Paradise Lost.*

Cowley.—Abraham Cowley (1618–67) was a contemporary of Milton of whom great things were thought during his lifetime and long afterward. Cowley produced no work of large design, but made translations and wrote *Pindaric Odes, The Mistress*, a collection of amatory verse, *Davideis*, elegies, and the like. He belonged to the metaphysical school of Donne, of whom he was a weak imitator. His cold conceits and extravagant fancies are passing into deserved oblivion. Sir John Denham (1615–69) was his superior in every natural gift, and wrote in a much higher school, philosophical but cold. His *Cooper's Hill*, his best work, will always command admiration for its nervous thought and fine imagery. It contains the fine apostrophe to the Thames:

> Oh, could I flow like thee, and make thy stream
> My great example, as it is my theme—
> Though deep, yet clear; though gentle, yet not dull;
> Strong without rage; without o'erflowing, full;

which is perhaps the most-to-be-admired example of that mosaic verse which was so much in vogue in the early part of the next century.

Of the prose-writers of the period of the Commonwealth, the most conspicuous and characteristic are Sir Thomas Browne (1605–82), Thomas Fuller (1608–61), Jeremy Taylor (1613–67), the Earl of Clarendon (1609–74), and Richard Baxter (1615–91). Browne wrote *Religio Medici, Pseudodoxia Epidemica, or a Treatise on Vulgar Errors, Hydriotaphia, or a Treatise on Urn-burial*, and *The Garden of Cyrus.* But notwithstanding the nature of these subjects and the fact that he was a physician, the interest of his writings does not consist in any contribution that he makes to morals, to science, or to the history of art. Their charm is only in the strange, fantastic thoughts which he weaves around his subjects in language which would have won him the applause of John Lyly, the Euphuist. His vocabulary is so Romanized that it is hardly English.

Jeremy Taylor.—Jeremy Taylor was a cavalier clergyman who became Bishop of Down and Connor, and has been called the Shakspeare and the Spenser of English prose. The latter comparison is the better. His style is like a rich tapestry full of glowing color and striking figures, that would be startling but for their beauty and their harmonious succession. Through the splendor of his fancy there runs a vein of sweet and tender yet glowing piety. His *Holy Living* and *Holy Dying* beget, even in this faithless day, a religious fervor in the reader. He has the honorable distinction of being the first earnest advocate of complete and absolute religious toleration, his argument for which is set forth in *Theologia Eclectica, a Discourse of the Liberty of Prophesying.* Fuller exhibited in the highest, most typical form the witty divine—a character assumed by many of the clergymen of his period. He has the credit of being one of the wittiest, although not one of the most humorous, of English writers. His principal works are *The Holy and Profane State, History of the Holy War*, and *The Worthies of England.* Clarendon was the first of the regular historians. His *History of the Rebellion and Civil Wars* is valuable chiefly because he was a witness of the facts which he relates with his judgment of the actors. His style is poor, often cumbrous, and often incorrect. Baxter was also a typical man. He was almost a perfect example of a clergyman who was a purely religious writer, rather than ecclesiastical or even theological. Fervor is his chief characteristic. His style is pure, and for its purpose it can hardly be, and never has been, surpassed. He wrote much, but is now chiefly known as the author of the *Saint's Everlasting Rest* and the *Call to the Unconverted.*

Bunyan.—Above all the prose-writers of this period, and high among those of any country of any time, rises the mighty figure of the Puritan tinker of Elstow, John Bunyan (1628–88). *The Pilgrim's Progress*, the book which has won its author a fame that like an English oak strengthens and broadens with the lapse of centuries, is an allegory purely religious in its original purpose; and of all allegories ever written it is the one which most effectually attained its end. It is a work of fiction, a tale of human experience and of human passion, a story of trial, of struggle, of sorrow, and of triumph. Thus considered, it is matchless; in all literature there is nothing like it. The secret of its influence is Bunyan's marvelous union of dramatic insight and dramatic power with a vivid and fiery imagination, beside which the imagination of all other prose-writers is pale and feebly imitative. Moreover, the style of *The Pilgrim's Progress*—not always correct, according to the laws of pedants and grammarians—shows a mastery of English in which its writer has no rival. It is an unconscious mastery, and it unites in absolute perfection, strength and delicacy. Of no book except the Bible, and perhaps Shakspeare's plays, have so many copies been printed; and of no book without exception have so many copies been read through and through again. It has been translated into nearly all the languages of the world; and of all peoples above the level of barbarism it has taken a mighty hold. Bunyan wrote another allegory of almost equal power, *The Holy War*; and his other works show his peculiar vigor of thought and of style.

To the period of the Commonwealth is assigned the appearance of the newspaper, which was to have such an influence upon society and upon literature. News-letters, as they were called, had been published earlier in the century, the oldest known being *News Out of Holland*, published in 1619; but it was not until the exciting times of the Long Parliament that the genuine newspaper was demanded by the eagerness of the public for information as to what was taking place from day to day. Published at first once a week, newspapers at last came to be published every other day.

Butler.—The political, religious, and social influences which were dominant during the Commonwealth were of an ascetic character, and tended to the repression of the lighter forms of literature. For several years the theaters were closed, the drama was crushed, and lyric poetry languished. Upon the Restoration the repressed forces of society burst forth, and with the extravagance of reaction ran riot in high carnival. One of the earliest of the enduring fruits of the rank new growth was *Hudibras*, a satirical poem by Samuel Butler (1612–80). The germ of this highly witty and humorous although coarse performance was in *Don Quixote.* In Butler's poem the hero is a Puritan knight in whom selfishness and hypocrisy take the place of the crazy chivalry and extravagant gallantry of the Knight of the Rueful Countenance. He, too, has a squire who greatly aids the dramatic movement of the composition. *Hudibras* was of course unfair to the Puritans, but it is choke full of knowledge of human nature, which is ventilated in witty expressions that succeed each other so rapidly and so sharply that it is like the letting off of a pack of fire-crackers. Not only Puritanism, but astrology, one of the weaknesses of the age, suffers dreadful exposure under the author's remorseless knife. Butler was the first English poet to make free use of double rhymes, upon the ridiculous effect of which many of his fine points depend. The couplet

> Compound for sins they are inclined to
> By damning those they have no mind to,

is a characteristic specimen of the gnomic portions of this immortal *jeu d'esprit.*

The dramatists of a period to which the court of Charles II. gave the tone were, as might be expected, not only free and gay, but licentious to the last degree. They reveled in the violation of external decency, and the nature of their plots was such that it would seem as if they were intended to illustrate the life of their royal master. All that they sought to present on the stage was amorous intrigue and wit; and it must be admitted that in both points they succeeded to admiration. Of the minor poets and wits of this period brief mention only can be made of Charles Cotton (1630–87), who, besides his indecent verse, wrote the second part of the *Compleat Angler* and translated Montaigne into sound and nervous English; Sir George Etherege (about 1636–91), who wrote three plays, the best of which is *The Man of Mode*, and who is the father of the modern comedy of intrigue; Sir Charles Sedley (1639–1701), a writer of exquisite wit and no less charming style; Wycherley (about

1640–1715); and the Earl of Rochester (1647–80), the most indecent and perhaps the most gifted of them all, and the author of the best epigram (written on the bed-chamber door of Charles II.) in the language:

> Here lies our sovereign lord the king,
> Whose word no man relies on;
> He never says a foolish thing,
> And never does a wise one.

Dryden.—The chief poet of this period was John Dryden, the son of a Puritan gentleman of Northamptonshire. He was born in 1631 and died in 1700. He began to write as early as 1649, but his most active period began in 1662. Dryden began his poetical career in the school of Donne and Cowley, and in the extravagant absurdity of his conceits he out-Heroded Herod. Whoever wishes to learn what conceit is in poetry may best learn by studying it in the form of monstrous and loathsome caricature in Dryden's *Lines on the Death of Lord Hastings.* But there was other stuff than this in the man, who merely began as most young geniuses do, whether in literature, in music, or in painting, by imitating some one of their predecessors. Dryden, however, was nearly forty years old before he showed his power, which is that of an impetuous flow of versification, embodying cogent argument, stinging satire, or graphic portraiture. Of passion, of tenderness, and of pathos he showed none in his poetry, having, it would seem, none in his nature. He is fierce, but never warm, impetuous, but never earnest. He shows great strength, but not the greatest, which always carries with it a delicacy of touch to which weakness can never attain. His sentiments are never of the highest or the purest kind. He belongs to the race of time-servers and men-pleasers. But his satirical power is almost equal to Juvenal's, and his portraits of his contemporaries—as, for instance, in *Absalom and Achitophel,* the best of his more important works—are grand historic caricatures, heroic in scale and in spirit. His best lyric composition, *Alexander's Feast,* was once thought the finest thing of the kind in English literature, but time has been gradually, and surely and justly, diminishing its reputation. He wrote thirty plays, both comedies and tragedies. They have little poetic merit and no real dramatic power. They were, however, written as many of the best works in literature were written, merely for the money they would bring. But in the prefaces to some of these plays Dryden stepped upon the field of dramatic criticism, of which he showed himself a master. They are the earliest work of the kind in the language, and they remain among the very best. Dryden was not a great poet, but he seems like a great poet in arrested development. The perpetuity of his fame is due to the splendor of his style and the vigorous freedom of his versification. He was in these respects, and by his power of crowding an epigram into a couplet or touching off a portrait in a quatrain, the introducer of a new school in poetry, which prevailed during the early part of the century succeeding his death.

The latter part of the seventeenth century was adorned by several prose-writers of eminence other than those already mentioned: Ralph Cudworth (1617–88), Andrew Marvell—also distinguished as a poet (1621–78), Algernon Sydney (1622–83), Sir William Temple (1628–98), Isaac Barrow (1630–77), John Tillotson (1630–94), Robert South (1633–1716), and Gilbert Burnet (1643–1715); as to whom, however, there is room enough only for their names.

Locke.—One man of this period, John Locke (1632–1704), demands particular attention as being an original thinker and one of the most eminent of England's philosophical writers. Locke is indeed the father of political and social ideas which since his time have shaped the political and the social development of the English race in Great Britain and America. In his *Considerations of the Consequences of Lowering the Interest and Raising the Value of Money* he first taught the political and commercial necessity of absolute good faith on the part of government as the creator of the legal representative of value and the medium of exchange of commodities, and that the issue of a depreciated currency was a breach of good faith. In his *Letter concerning Toleration* he not only nobly sustains the arguments of Milton and Jeremy Taylor on the same subject, but he broaches the theory now established and acted upon, that the function of government is to make secure the personal liberty and the civil interests of the individual, and that when it attempts to do more it oversteps its proper limits. His *Treatises on Civil Government* develop and enforce this important political theory, resting it chiefly on an implied contract between the governing power and the governed. His *Thoughts concerning Education* have controlled, and wisely controlled, the action of the English peoples almost until the present time, although the cold austerity of his views has been modified by a warmer infusion of parental feeling. But it is his *Essay concerning Human Understanding* which has given him his most enduring fame and power, in that he was the first to popularize the study of mental philosophy, and to turn the mind's eye of the whole world inward upon itself. To John Locke more than to any other writer is owing the introspective character of the literature, even the imaginative and fictitious literature, of the nineteenth century. Of Locke it was admirably said by Mackintosh that "his writings have diffused throughout the world the love of civil liberty, the spirit of toleration in religious differences, the disposition to reject whatever is obscure, fantastical, or hypothetical in speculation, to reduce verbal disputes to their proper value, to abandon problems which admit of no solution, to distrust whatever can not be clearly expressed, to render theory the simple explanation of facts, and to prefer those studies which most directly contribute to human happiness." His style has the fault of being in spirit unimaginative and in form too diffuse and vague.

Newton.—Contemporary with Locke were two distinguished men of science, one of them very eminent—Robert Hooke and Sir Isaac Newton. Hooke (1635–1703) was an investigator and an inventor, but chiefly a critic and a disputant, presuming, ill-tempered, and insolent. He did not hesitate to attack Newton's theory of light and colors. Newton (1642–1727) is admitted to have been the greatest master of exact science that ever lived. His discoveries of the law according to which the force of gravitation acts, and of the refraction and composite nature of the ray of light, are the most important in their kind of modern times. His genius, although sublime and far reaching, was eminently practical; and to him England was indebted for the regulation of the dire confusion of her coinage. His works hardly come within the range of pure literature, but the splendor of his genius and the grandeur of his fame forbid them to be passed by without notice.

Locke and Newton were the great literary and philosophical ornaments of the reign of William and Mary, which was sadly in need of all the glory that could be shed upon it by their genius; for the Revolution of 1688 crushed literature far more effectually than that did which brought in the Commonwealth; one reason of which doubtless is that there was a much feebler thing to crush. For twenty years the annals of literature are bare of interest except that which attaches to Locke and to an early performance of Matthew Prior's *The Country Mouse and City Mouse.* But Prior's career (1664–1721) stretched well into the eighteenth century, in the first quarter of which appeared that galaxy of admirable writers known as the wits of Queen Anne, among whom Prior must be reckoned. The others were Swift, Pope, Steele, Addison, Gay, Garth, and Arbuthnot, of whom the last three, with Prior, may be passed without further notice.

Swift.—Jonathan Swift (1667–1745), Irish by birth but the most English of men by blood and nature, first appeared in literature by the publication in 1704 of his *Tale of a Tub* and *Battle of the Books,* the former a religious satire, the latter a literary one, both highly flavored with a coarse kind of comedy. The success of these works was very great, and their reputation has continued even to the present day. But it is safe to say that only their reputation has survived; and that there are few even of the most cultivated readers nowadays who can read these comic allegories (for such they are) with much enjoyment of their wit, or even with a very keen appreciation of their satire. But their writer has few equals as a wit or as a satirist in any literature. When he stepped upon the broad field of human nature he produced that which will be the source of delight and instruction until human nature has become other than that which he found it. It is as the author of *Travels by Lemuel Gulliver* that he commands the widest circle of readers. This production had a political purpose, like most of its author's works, and contains allusions to and caricatures of some of the statesmen, churchmen, and other public men of that day; but the genius of its author impelled him to deal with mankind even more than with party, and his satire is upon the human race. This is indeed the weakness as well as the strength of Swift's writing—his contempt for his fellow men. His own personal tastes, no less than his personal feelings, put in a strong appearance in all his writings; and nothing does he show with so little reserve as his aversion from his kind. The disgust which he makes the king of the horses in his *Houyhnhnms* feel for the Yahoos is plainly but an utterance of his own sentiments. Notwithstanding an indecency which does not consist in a public exposure of those ardent passions which the least reserved of men conceal, but in a reveling in physical filth, Swift's insight into men's motives is so keen, his satire is so splendid, as well as so savage, his wit and humor are so fine and so continuous, and his style so simple and so nervous, that great pleasure and good counsel can be extracted from almost all that he wrote. He has been compared to both Rabelais and Cervantes. He was far below either in spirit and purpose, but more like the former than the latter in his style. He wrote poetry, or rather verse, which had all the characteristics of his prose, and no others, being entirely without imagination, fancy, or beauty of form. His best known works, in addition to those already mentioned, are the *Drapier Letters*, *Polite Conversation*, *Directions for Servants*, and *Modest Proposal for preventing the Children of Poor People in Ireland from being a Burden to their Parents, and for making them Beneficial to the Publick*—to wit, by eating them.

Pope.—Alexander Pope, born 1688, began to write verses in his childhood, and before he was thirty years old had amassed a moderate fortune by his pen, and had taken a position which makes his name the most illustrious in the literary roll of the eighteenth century. Pope's first work of conspicuous merit was the *Essay on Criticism*, written when he was but twenty-one or twenty-two years old. Containing no new or striking views of literature, it is yet admirable for the soundness of its judgments and the epigrammatic elegance of its style. His *Rape of the Lock*, a mock-heroic poem—in fact, a burlesque social epic—is the most charming and exquisitely finished composition of its kind ever written. Pope was, like Dryden, whom he began by imitating, a satirist, and, like Swift, an egoist. But, unlike either of them, he had tact and delicacy, and was an accomplished man of the world. Where one used a broadsword, and the other a bludgeon, he used a rapier. His mind had also a strong philosophical turn, and this he showed in his *Essay on Man*, which is the finest didactic poem in any language, unmatched for closeness of thought, felicity of illustration, and delicacy of finish. He never wrote with passion or with strong imagination, but in his *Epistles of Eloisa to Abelard* and *Sappho to Phaon* he did attain a warmth of feeling which is almost like the fervor of real love; and in writing of his own feeble, crippled, weary, physical life (*Epistle to Arbuthnot*) he utters his woes with a simple pathos which is touching and dignified. With the assistance of some minor versifiers of the day he translated Homer, making a brilliant and very readable version, which has the one great defect of misrepresenting the original both in form and in spirit. He edited Shakspeare, but his real editorial work is of little worth, and the only valuable part of the edition is in the preface, which is full of excellent criticism written generally in admirable English. Pope was not a great poet; he was rather a colossal epigrammatist and the most skillful of versifiers. He wrote almost always in a ten-syllable heroic couplet, which he brought to the highest perfection of which it seems to be capable. He died in affluence in 1744, having established a school of poetry, and left hosts of imitators, who filled the first half of the eighteenth century with evidences of how easy it was to imitate his form, but how hard to attain his finish or to approach his style of thought. His last important work was the *Dunciad*, a savage satire not easily understood now by those who are not familiar with the literary squabbles of his day.

Steele and Addison.—Two of the eminent men of this period, Richard Steele and Joseph Addison, are free from the reproach of injurious motives and of egoism, and remarkable for the humanizing and elevating purpose of their writings. The former deserves praise for introducing into English literature the brief periodical essay, which since his time has held such an important place, and additional praise for bringing to light the remarkable powers of the latter, the master of this kind of writing. Steele began the publication of the *Tatler* in 1709. It appeared three times a week, and only a few numbers had been published when he induced Addison to become one of its regular contributors, the others being Swift and Hughes. Addison wrote about fifty papers. Afterward in the *Spectator* Addison assumed a more important position, and wrote most of the papers which gave that publication its unrivaled reputation. The purpose of Steele and Addison was the elevation of English society in intellectual and moral tone, and in manners. This they accomplished by a series of papers which have never been surpassed in the easy charm of their style, and in which wit and satire were directed, not against individuals, but against grossness, meanness, and frivolity, and did more than any one other single agency to diffuse a taste for literature, for art, and for all the refinements of social life among English-speaking peoples. Addison's style, although not nearly so correct as it was once supposed to be, deserves for many qualities all the admiration that it has received. For its constant grace and its general clearness, for lambent humor, for good nature, wit which like Ariel's music gives delight and hurts not, for a certain tone of social elegance, and for a purity far remote from squeamishness, it has no superior, hardly an equal. Addison's literary criticisms in the *Spectator* first raised that department of English literature into a recognized art. To him, as it has been said above, English literature owes the establishment of Milton's fame. In this respect, as in matters of society, he was a benefactor to the English people. Nor was Steele much behind him. Less profound and subtle than his great colleague, less exquisite in his humor, he had a larger heart and a richer nature, and there is a warm cordiality in his writing, the lack of which is Addison's chief defect. But throughout the papers published by this admirable pair, there is a dignified familiarity which has a peculiar charm, and the characters to which they introduce the reader become valued acquaintances, and almost friends. Sir Roger de Coverley is not only an historical type, but a man whom one grows to love and admire. Steele and Addison both wrote plays, the former a few comedies of some merit, the latter a cold, didactic, classical tragedy, *Cato*, which enjoyed for a time a considerable reputation. But it is as the essayists of the *Tatler*, the *Spectator*, and the *Guardian*, that their names live in grateful memories. Addison died in 1719, Steele in 1729. Like Pope, they established a school, and their century was filled with their imitators, whose writings, often not without merit, demand no particular attention. But mention should be made, also, of Lady Mary Wortley Montague (1690–1762), whose letters are models of the familiar epistolary style.

Congreve.—Three writers who gave some brilliancy to the English stage in the reigns of William III. and of Anne—William Congreve (1670–1729), Sir John Vanbrugh (1666–1726), and George Farquhar 1678–1707). Congreve was the man of the highest aims. He was poetical, if not a poet, and wrote sententious verse in a dramatic form. His tragedy, *The Mourning Bride*, contains some passages which are still remembered; in his comedies his wit keeps up a continual flash as of heat-lightning. But he created no character and had no real dramatic force. Vanbrugh had what Congreve lacked, and lacked what Congreve had, except wit. His plots are ingeniously constructed, and his characters are strongly if not truthfully drawn. Farquhar's comedies are chiefly remarkable for a flow of animal spirits. But no one of these men added much to the real glory of the English drama.

Defoe.—In the year 1719 there appeared a work of fiction which has been more widely read than any other in English fiction, except, perhaps, *The Pilgrim's Progress*. It was *The Life and Strange Surpassing Adventures of Robinson Crusoe, Mariner*. Its author, Daniel Defoe (1661–1731), was then fifty-eight years old, having passed his life until that very mature period chiefly in writing an almost incredible number of political pamphlets in favor of liberal or Whig principles. *Robinson Crusoe* immediately commanded the attention of all sorts and conditions of men. It was read with avidity, and not only with avidity, but with credulity. It was not looked upon as a novel, a fiction from beginning to end: it was accepted as a plain, unvarnished narrative of fact. And in the quality which caused it to produce this impression is its great and its only merit. Defoe has, in a greater degree than any other writer, the art of giving to fiction the air of reality. This effect is a consequence of a certain strength of imagination; but it is also due in a great measure to the continuous relation of trifling, matter-of-course, and utterly insignificant events, which, being told naturally, seem as if they were part of a life passing minute by minute before us—an inferior kind of imagination and of constructiveness, reducing that which is produced by it to the lowest level of the real school of art. Defoe was a manly and incorruptible political writer; but as a literary artist he had the grand and fatal defects of a want of passion, of sentiment, and of tenderness, and also of any remarkable insight into character and power of portraying it. His *History of the Plague* is as real-seeming as *Robinson Crusoe*, and is almost as purely fiction. His other works are now little read, and his satirical poem, *The Trueborn Englishman*, is known chiefly by name.

After Swift and Pope and Addison and Steele had ceased to write there was a long dearth of originality in English literature. But contemporary with them, or immediately following them, are the poets Matthew Prior (1664–1742); Isaac Watts (1674–1748); Edward Young (1681–1765); Thomas Warton (1687–1745); John Gay (1685–1732); William Collins (1721–59), whose *Odes* are among the best in the language; and, far superior to all the others, yet still a poet of the third or fourth class, James Thomson (1700–48), author of *The Seasons* and *The Castle of Indolence*. Among the prose-writers of the period the following demand honorable mention: Richard Bentley (1662–1742), eminent as a classical scholar and critic; Lord Shaftesbury (1671–1713), whose *Characteristics* is elegant, independent, thoughtful, but not profound; George Berkeley (1684–1753), who became Bishop of Cloyne, and who broached an ideal system of philosophy, the cardinal principle of which was that perception is all that is known of reality; and Lord Chesterfield (1694–1773), the apostle of etiquette and good breeding.

Richardson.—In the middle of the eighteenth century the English people were startled by the appearance in fiction of *nature*, an element which had been previously unknown. Defoe's power had been that of reality, which is akin to nature, but is not nature. The new style was introduced by Samuel Richardson (1689–1761), a man born in humble life, bred to a mechanical trade, and finally a bookseller. At the age of fifty-two he produced *Pamela*, which was followed by *Clarissa Harlowe* and *Sir Charles Grandison*. The success of these books, particularly of the first and second, was prodigious. But as one looks back at them, and wades through the endless succession of letters from and to their high-strung, sentimental heroines, he wonders at the avidity with which such masses of moral "spooning" were devoured, and can attribute such appetites only to a long course of starvation. Or, as Scott, in his explanation of this phenomenon, says, "Had we been acquainted with the huge folios of inanity over which our ancestors yawned we should have understood the delight they must have experienced from this unexpected return to truth and nature." Richardson was minute, like Defoe, and his personages being flesh-and-blood creatures of the period, and his sentiment genuine of its kind, although inordinate in quantity, he also awakened the keen interest which always watches over the vicissitudes of those whose experience is what we feel that ours might have been. But his books are a weariness to the flesh. It may be possible for some people now to read all of *Pamela*, but who for two generations has been able to struggle through *Clarissa Harlowe* and *Sir Charles Grandison*?—the hero of which is like a Washington in plain clothes turned beau, and eternally bowing over the hand of some pretty piece of female propriety, who worships him as if he were a fetish. But Richardson was the occasion of the appearance of a real master of human nature. Henry Fielding (1707–54), a gentleman by birth and a man of liberal education, was tempted to write a burlesque of *Pamela*; and, as in the case of some other performances of like motive, the burlesque proved more true to nature than the original. Fielding's novel was *Joseph Andrews*; and as *Pamela's* chief object of life was to preserve through six or seven volumes the point of female honor, so Joseph, her supposed brother, devotes himself to the assertion and preservation of his continence against the wiles of the opposite sex. The vigor and spirit of Fielding's style and his creative power have never been surpassed. He showed that highest ability in fiction, the power of creating personages which are at once individuals and types. His Parson Adams, Lady Booby, Squire Western, Tom Jones, and Amelia have a vitality and a truth far above that which is producible by the most elaborate work in the realistic school. They come from a knowledge of the real, from which the truth of highest art eliminates the non-essential. They are created from within, not built up from without. Fielding's humor is rich, free, and pervades his comic scenes like the natural atmosphere. That he was sometimes coarse, according to modern standards of taste, is the fault of his time. Tobias Smollett (1721–71), who soon appeared upon the field, was a much coarser artist. His object seems merely to tickle his reader into laughter by a succession of scenes which seem like farce put into narrative form. But he has fine touches of satirical humor, and his *Peregrine Pickle* and *Roderick Random* and *Humphrey Clinker* will always give pleasure to readers of robust tastes and strong stomachs. In the latter part of his life he wrote a continuation of the history of England from the point to which it was brought down by David Hume.

Hume.—David Hume (1711–76) a Scotchman, first appeared in the field of philosophy, in which he showed himself an original and daring thinker. His philosophical works are a *Treatise on Human Nature* (republished as *Philosophical Essays concerning the Human Understanding*), *An Inquiry concerning the Principles of Morals*, and *The Natural History of Religion*. In the treatment of these subjects he disregarded authority and accepted belief, making fact and reason his only guides. He was by nature a doubter and an inquirer. These works placed him in the front rank of modern moral and metaphysical writers, and produced an effect which seems destined to be permanent. His views as to the possibility and the necessity of miracles arrayed against him all the theologians of his day; but a large number of the ablest and most sincere theologians of the present time accept his views as being sound in the main and not at war with the interests of true religion. Having taken this position, he turned his attention to history, and wrote in three instalments what is known as his *History of England*, bringing his work down to the Revolution of 1688. This work is not of high authority as to matters of fact, and it is strongly tinctured with the writer's personal prejudices. But its happy arrangement, the clearness and vivacity of its style, its charity and toleration of spirit, notwithstanding the obvious prejudices before referred to, make it one of the most interesting of modern histories, as it was the first of the modern school of historical writing. Hume's style is too strongly marked with Northern peculiarities to be regarded as a good example of standard English.

Gibbon.—Contemporary with Hume, but younger, was Edward Gibbon (1737–94), who produced between 1776 and 1788 his *History of the Decline and Fall of the Roman Empire*, a work upon which he was engaged for twenty years. The magnificent plan of this history, the vast extent of time which it covers, its colossal erudition—it being the fruit of original investigation of facts hidden for the most part in the dimmest recesses of the Dark Ages—and its imposing style, make it the greatest work of its kind known to literature. Its style, however, is too conscious, too pretentious, too much infested with Romanic words and Gallic forms of thought, to be regarded as really English.

Contemporary with the two distinguished historical writers, though not as eminent as they, was William Robertson (1721–93), who wrote the history of Scotland, of Charles V., and of America—works of sound and unpretending merit, written in an agreeable style, somewhat too strongly marked with Scotticisms.

Gray.—The middle of the eighteenth century was adorned by the highly finished poems of Thomas Gray (1716–71), whose function in poetry seemed to be to show how high a point could be reached by a man who had a poetic nature, strong poetic feeling, and an exquisite ear for rhythm, but was without genuine poetic inspiration. Gray's *Elegy Written in a Country Churchyard* has probably been more widely read than any other poem in the language, and it has certainly furnished more phrases to its collection of household words than any other that ever was written; almost the whole of it has become a part of familiar speech. It is a beautiful union of tender thoughtfulness and graceful expression. Contemporary with Gray was William Shenstone (1714–63), a poet of considerable merit, whose best-remembered work is *The Schoolmistress*, an admirable imitation of Spenser's style, but more admirable as a poetical picture of a type and of a time.

Sterne.—To this period, too, belong the works of Laurence Sterne (1713–68), one of the greatest humorists found in any literature. His is the only humor that could be named with that of Shakspeare or of Cervantes. His satire has the charm of a delicacy so exquisite that it seems like pungent aroma filling the atmosphere of his thought. His style has a corresponding daintiness, although it is sometimes disfigured with affectation. Admiration of *The Life and Opinions of Tristram Shandy* and of *A Sentimental Journey through France and Italy* has grown with the passage of each year since their first appearance.

Johnson.—Throwing the shadow of its sad humanity all athwart the latter half of the eighteenth century stands the burly bulk of Samuel Johnson (1709–84), one of the most miscellaneous, and really one of the most desultory, of writers. He was a poet, a dramatist, an essayist, a biographer, and a lexicographer. In fact, like many other literary men of equal and of less note, he wrote for bread that which he was called upon to write; but he impressed upon all that he did write the stamp of his own strong individuality. His purely literary fame was acquired chiefly as a moral and a critical writer. Not always just, not always right, he is distinguished by a love of truth and of purity, by sturdy independence and colossal common sense. Of original thought he produced little, but he added to axioms the charm of novelty by the earnestness and the weight with which he gave them utterance. His style, too ponderous and too formal, has nevertheless the great merit of clearness and of strength; and slipshod writers would do well to take a hint from his advice in regard to Addison, and devote their time to the study of "the Johnsonian period." His *Rambler* essays, which he wrote twice a week for two years, exhibit in their most characteristic form his merits and his defects as a writer. If heavy sometimes in style, they are always laden with the weight of humanity. Johnson's *Dictionary*, having been compiled before the establishment of the modern school of comparative philology, has comparatively little etymological value, but it was the first English dictionary made upon the proper principle of an investigation of the history of words as exhibited in English literature; and it has been the model and the quarry of almost all subsequent works of its kind. Johnson is, however, best known through the minute report of his daily life and his intercourse with his literary friends, furnished in his memoirs by James Boswell. He was a sort of king in the literary circles of his time, and exercised a personal influence, the effects of which long survived him.

Adam Smith.—Among Johnson's eminent contemporaries two must be passed by with mention inadequate to their fame—Adam Smith (1723–90), who has the honor to be the founder of the science of political economy; and the unknown writer who, under the signature of *Junius*, was a terror to the statesmen of his time, and even of his party, and who remains the great English master of invective. The style of the letters of Junius is still worthy of all the admiration of which they were ever made the subject; and that of the best political leading articles in the journalism of subsequent times owes much to those celebrated letters, which may be said to have founded the modern school of anonymous and irresponsible journalism.

Burke.—It is remarkable that of the great masters of modern English, four of the greatest were by birth and early education Irishmen—Swift, Sterne, Goldsmith, and Burke—and of these the foremost is the last. Edmund Burke (b. about 1738) is the greatest master of English prose. Goldsmith is his equal in purity, simplicity, and grace; but in Burke there is a fullness of thought, a wealth of words, a sustained power of utterance, a grand sweep of the period, with a subtle yet most naturally inwrought richness of illustration, to say nothing of mere accuracy of expression and clearness of construction, which place him far beyond all other writers. Burke's mastery of language is like Beethoven's mastery of melody and harmony. His department of literature is that of philosophical statesmanship, in which he stands side by side with Cicero, if not a little before the great Roman. The saying that he to party "gave up what was meant for mankind" is one of those glittering fallacies of thought which poets have unfortunately the power of perpetuating. On the contrary, his fault as a party man was that he thought too much of mankind and had too much poetic feeling—thought perhaps not always logically, and sometimes with too much sentiment of the highest kind, but rarely in unwisdom. Indeed, he is the wisest of all modern politicians. His *Reflections on the Revolution in France*, *Letter on a Regicide Peace*, and *Letter to a Noble Lord* are his principal works. Of his purely literary essays, that on *The Sublime and Beautiful* was at first widely known and read. But among the earliest fruits of his laborious life it is that of the least permanent value. His strength grew with his years, and his most powerful as well as his most brilliant efforts were made after he had passed his meridian, and even just before his death, which took place in 1797.

Goldsmith.—Of Oliver Goldsmith (1728–74) Dr. Johnson well wrote, "Nullum quod tetigit non ornavit," and he touched many things, but he lives in literature as the author of four works: a novel, *The Vicar of Wakefield*, a comedy, *She Stoops to Conquer*, a poem, *The Deserted Village*, and a satirical criticism of society, *The Citizen of the World*. He wrote other poems, many essays, and much criticism, all charming in style and full of humor and a gentle wisdom, but the works named above are his masterpieces. The *Vicar of Wakefield*, faulty in construction, is matchless and immortal as a gentle revelation of the weakness of human nature, and stands first among novels of English domestic life; and *She Stoops to Conquer* is, whether for its construction or its humor, the best comedy of the same range in English dramatic literature.

Cowper.—The eighteenth century was rounded with the life of a poet, William Cowper (1731–1800), who to minds of a religious tone and unspeculative cast speaks in accents which comfort them and sustain their faith. He is pre-eminently the poet of Christian morality, of true piety, and of all the softer and sweeter social graces. Incapable of bitterness, he was not incapable of gentle and dignified satire; and although his style has too much of the formality and conscious precision of his time, he has many passages marked with great sweetness and freshness of feeling. His longest and most ambitious original works are *The Table Talk* and *The Task*, but incomparably his best are his *Lines on my Mother's Picture*, and *John Gilpin*, an outburst of pure fun and humor strangely and delightfully incongruous with his usual style. He translated Homer very ambitiously, but without corresponding success.

Burns.—Robert Burns (1759–96), who died only four years before Cowper, was the greatest writer of English poetry born north of the Tweed. He is regarded as a "Scotch" poet, but even his "Scotch" poems are in a mere dialect of the English language, as has been remarked; some of his more serious poems, and not a few of his songs, are in as pure standard English as any compositions of his contemporary, Cowper himself. As a lyric poet, Burns, when we consider both the number of his poems and their merit, must be placed at the head of his class. No songs so full of the direct utterance of passion, of tenderness, and of love-lit fancy exist in the English language—hardly in any other; and his idyls spring from the soil like grass, and with the purple bloom and the sweetness of heather. Entirely uninstructed, he was fashioned by Nature from his cradle to be her singer. The very trials of his shifting life, the very failings of his unstable character, were to him sources of the purest poetic utterance. He indeed did learn in suffering what he taught in song. Having wrecked his life upon his passions, and wreaked his woes upon expression, he died in misery, and left a name around which burns a glow of tender glory. Two of his countrymen deserve mention among the poets of their land—James Hogg (1770–1835) and Allan Cunningham (1784–1842).

Colonial Authors.—In the eighteenth century the English race began to manifest its power in a new land. The men who had left the old England, and had crossed the Atlantic to found a new England free from some of the civil and religious restraints which galled them in the land of their birth, were, very many of them, not only energetic and enterprising, but intelligent, and of more than moderate intellectual and social culture. In New England education was one of their earliest cares. Colonial literature has, however, nothing worthy of notice in a sketch like the present (for the Mathers, Increase, the father, and Cotton, the son, produced nothing that has any intrinsic literary value) until Jonathan Edwards (1703–58) is reached, a theological and metaphysical writer whose power was at once recognized in the mother country, and whose *Enquiry into the Freedom of the Will* is still the stronghold of the necessitarian theologists. He merited the judgment pronounced by his biographer, Mark Hopkins, that he was a man of considerable learning, extensive reading, sound judgment, and great argumentative acuteness.

Franklin.—The next author eminent among his countrymen was Benjamin Franklin (1706–90), apostle of common sense. Franklin was a philosopher, but in his company Philosophy wore her homeliest garb and addressed herself by the simplest means to the most practically useful ends. He was above all things "utilitarian," of which school in social science he was one of the founders. He is hardly better known for his discoveries in electricity and the great diplomatic services he rendered the colonies at European courts than for the prudential maxims of his *Poor Richard's Almanac*. His style is very plain, clear, and convincing. Among Franklin's younger contemporaries were the men who roused the colonists to resistance to the tyrannical government of George III., and finally brought about the severance from the mother country—John Adams (1735–1826), Thomas Jefferson (1743–1826), Patrick Henry (1736–99), Thomas Paine (1737–1809), John Trumbull (1750–1831), Philip Freneau (1752–1832), and Alexander Hamilton (1757–1804). Of these, Adams was sound in judgment, logical in reasoning, a lawyer, and a man having respect for authority and demanding respect for it; Jefferson, a calm but earnest and persistent advocate of equality before the law in all things, whose authorship of the Declaration of Independence not only secures him immortality, but gives him some claim to having helped to light the fires of the French Revolution; Patrick Henry, an orator of masculine tone and fervid phrase, equally daring and dexterous; Thomas Paine, an intellectual iconoclast and a rebel against all authority, whose *Common Sense* and *Rights of Man* have done more to spread skepticism, if not to quicken it, than any other books ever written; Philip Freneau, a poet of genuine patriotic feeling and lyrical skill; Hamilton, a statesman of true formative power, who was endowed with the ability of uttering his schemes and putting his arguments in a style of remarkable elegance and force. He was the principal author of *The Federalist*, a series of papers which did much to bring about the formation of the American Union. But the place of all these men in literature is not a notable one, and is very inconsiderable compared with that which they filled in the great political movement of their time. They had very little influence on the literary tone of their own country, and are hardly discernible in the great stream of English literature which now flows yearly fuller and stronger with the inpouring of its American tributary. But it was not until well on in the first quarter of the nineteenth century that Anglo-American writers showed native, independent power.

NINETEENTH CENTURY.

The period succeeding the American war of Independence and the French Revolution was one of great activity in English literature, all departments of which were filled by a throng of new writers who sprang up with the spontaneousness of mushrooms, but not with their shortness of life. And now, as the names of authors increase—authorship having become so common that everybody writes, learned and unlearned—and as a period within the memory of living men has been reached, remarks, even upon writers of eminence, must be more brief than they have been heretofore, and for the sake of convenience the various departments of literature will be considered each by itself.

Poetry.—The bonds of continuity between eras, however unlike, are rarely if ever entirely wanting unless they are broken by some prolonged as well as violent political and social convulsion, such as has been remarked in the case of the Wars of the Roses; and the link that binds the poetry of the eighteenth century to that of the nineteenth is George Crabbe (1754–1832), in whose works both the form and the spirit which more or less pervaded English poetry from the time of Pope to that of Wordsworth are so manifest, yet with the modification produced by a tendency toward the contemplation of simple nature and of the reality of lowly life, as to win him the sobriquet of "Pope in worsted stockings." Crabbe's poems show close observation, a loving sympathy with nature, and not a little shrewd humor. Walter Scott (1771–1832), who followed soon after him, was very unlike him in the choice of his subjects and the style of his versification. Scott is the poet of chivalry and romance, and the story of his poems is always removed from modern times; he writes loosely and freely, but with great spirit and vivacity of movement; his fancy flies low, but his imagination is strong, and his love of nature and of the external signs of man's presence, as churches, castles, and buildings of all kinds, is very great. No poems ever received so quickly so large a share of public attention as his. They effected an entire change in the poetic taste of the time. After working his peculiar vein out, he turned his pen to prose fiction.

Byron.—Scott was replaced in favor, as a poet, by Lord Byron (George Gordon Noel, 1788–1824), who, entirely unlike him in the spirit of his poetry, had strong points of resemblance to him in the form and structure of his compositions. Like Scott's, Byron's principal poems are narrative, and have a freedom of versification and ease of style entirely opposed to the eighteenth-century manner. The heroic couplet and the epigrammatic period had disappeared from English literature, perhaps for ever. Byron's style is rich, sensuous, and brilliant; his motive rarely high or pure. He is satirical, but because of a contempt for his kind rather than a hatred of what is bad and base. His descriptions, whether of natural objects or human action, are truly splendid; and in some passages, notably in his greatest work, *Childe Harold*, he rises into the higher regions of poetry. But the tendency of his writings is debasing, less because of their sensual and epicurean tone than by reason of their derangement of the moral perceptions and their defiance of the moral sense. His heroes are unnatural combinations of incongruous qualities; his women mere compounds of beauty and unrestrained passions; and a gloomy and fierce egoism pervades his writing. But he is the richest in style and the most copious in fancy of all modern English poets. He was followed in public favor by his friend Thomas Moore (1779–1852), a poet of Irish birth, who wrote *Lalla Rookh*, *The Loves of the Angels*, and *Irish Melodies*, but whose real excellence was in lyric compositions. Moore's songs are charming in their tenderness, their lively fancy, and the sweet cadence of their verse, but they do not rise into the highest range of lyric writing. They smack of society, and have about them the odor either of the drawing-room or the dinner-table.

Campbell.—Next in the galaxy of poets which distinguished the reign of George IV. comes Thomas Campbell (1777–1844), a Scotsman by birth and a Celt by blood, who yet stands high in the annals of English literature. His *Pleasures of Hope* and *Gertrude of Wyoming* are his longest and his most ambitious poems. They are full of bright fancy, generous sentiment, and earnest humanity of feeling. But his lyric poems are his best, and they are of a very high order. They have the true fire and energy of the highest lyric school, mingling in rare combination, fancy, passion, and reflection. His critical and biographical writings added largely to his literary reputation. Percy Bysshe Shelley (1792–1822) and John Keats (1795–1821) should be noticed here, although greater names await mention. They both lived uncompleted lives, neither of them producing a work which attained the excellence of which they seemed capable. Shelley's life was one of revolt against society, and his longer poems are an utterance of his rebellious spirit. His minor poems express the exquisite tenderness and sweet fancies of a really lovely nature. Keats's *Endymion* and *Eve of St. Agnes*, full of beautiful passages, lack the coherence and consistency of style requisite in poetry of a high order; but perhaps it may justly be said that he died too young for us to know the real caliber of his mind.

Among the poetical writers of this period these must be mentioned: the brothers Horace (1779–1849) and James Smith (1775–1839), the authors of the famous *Rejected Addresses*, parodies or burlesques of subtle humor and inherent merit; Mrs. Felicia Hemans (1793–1835) and Miss Letitia E. Landon (1802–38), both graceful and sentimental poets; Robert Montgomery (1807–55), the author of *Satan* and other religious poems; Theodore Hook (1788–1841), the author of irreligious poems and jests that belied his name; Joanna Baillie (1762–1851), known as the authoress of an elaborate series of *Plays on the Passions* which could not be played and are never read; and Sir Thomas Noon Talfourd, a common-law judge, whose one tragedy, *Ion*, made a lasting reputation for him and for more than one representative of its title part, and is read with delight by those who eschew the theater.

Wordsworth.—At this time appeared what was styled the Lake school of poets, the first of whom was William Wordsworth (1770–1850), whose poem, *An Evening Walk, addressed to a Young Lady from the Lakes of the North of England*, was probably the occasion of the name given to him and his imitators. Wordsworth began to write in the old style, as appears by some poems written in 1786 which he preserved. But reaching manhood, he broke loose from this style, and set out to reform English poetry, and his effort was toward an admirable end—simplicity and truth to nature. One means by which he hoped to attain his end was, in his own language, "fitting to metrical arrangement a selection of the real language of men in a state of vivid sensation." He failed in accomplishing this end, which is incompatible with the requirements of any poetry; and one result of his efforts in this direction was the putting in some form of verse, generally a sonnet, almost every incident of an externally prosaic life. All his best works had their excellence (as his friend Coleridge said) in a treatment entirely at variance with his own theory, in conforming to which he produced of what was good only some short and simple poems of a remarkably picturesque beauty; but the rest of his verses, wrought out according to his theory, excited only the ridicule of his contemporaries, and have fallen into merited oblivion. Wordsworth in the best manifestation of his powers was a descriptive philosophical poet. He lacked passion, had no dramatic power, even enough to take himself out of himself, and his constructive ability was small. Of lyric power he had none whatever, and his versification has no peculiar charm. But in two styles of poetry he is without a superior, almost without an equal, in English literature. The first which is almost peculiar to himself, is marked with a thoughtful and tender simplicity in the expression of the feelings of very humble people. It may be regarded as a very refined and elevated style of ballad-writing, the fidelity of the best old ballad style to the facts of nature being carefully preserved. The other style—and that in which the greater part of his best poetry is written—is speculative, deeply penetrative into the human heart and the relations of man with God and nature. It is grand, but when prolonged becomes somewhat wearisome. His sonnets, which are very numerous, are, with a few conspicuous exceptions, cold and dry, and seem, too many of them, to have been written under the pressure of a sense of duty. He wrote much, but room can not be spared even for the enumeration of his important works. He was made poet-laureate in 1844, succeeding Southey. Robert Southey (1774–1843) wrote much verse, but little that can be termed poetry. What he might have produced had he concentrated his efforts can not be told. But he surely might have been one of the first of English prose-writers. The amount of writing that he did in verse and prose is really prodigious. But the essence of poetry is concentrated thought, or at least concentrated expression of thought; and that he lacked. He was in all things diffuse, although clear and simple and manly in style. His English is much admired by the best critics. But he was without originality even in style. Of all his verse not a line or a phrase has passed into the phraseology of common life except one—"deeply, darkly, beautifully blue"—which owes its circulation to Byron's having quoted it. Of all his works only his rambling, humorous *Doctor* is now read; but he was one of the most conspicuous literary personages of his time.

Coleridge.—Among the associates of Robert Southey and Wordsworth was Samuel Taylor Coleridge (1772–1834), a man who, if he had been content with being only a poet, would have been a poet of the highest rank, excluding the three who stand together—Homer, Dante, and Shakspeare. Coleridge began life by being an enlisted dragoon; he next projected a utopian republic on the banks of the Susquehanna; next he became a Unitarian preacher; he afterward turned Trinitarian and Tory; and he passed the remainder of his life writing and talking with a marvelous mingling of grandeur and subtlety, but leaving nothing complete except a few short poems. He was one of the last of the great talkers, the very last being Macaulay; and like him he spoke soliloquy. The author of *The Ancient Mariner*, of *Christabel*, of *Love*, of *Genevieve*, of the *Hymn to Chamouni*, of *The Devil's Walk*, of the lines upon *Cologne*, and the translator of *Wallenstein* had the capacity of a great poet of very varied powers. But he was beset by the demon of criticism, that foe of the creative faculty; he could not resist the temptation to wander away into the fields of metaphysical speculation; he sapped his mind and shattered his body with opium-eating; and so he ended his life, a splendid wreck, leaving the wealth that he bore scattered upon the shores of immortality.

Samuel Rogers (1763–1855), the banker-poet and the author of the *Pleasures of Imagination*, was a writer who formed himself rather upon the eighteenth-century models, and who, as Byron said, "when he was delivered of a couplet took to his bed and tied up his knocker." Thomas Hood (1799–1845) was one of the most charming of English humorous poets, and one who combined his humor with a pathos peculiarly his own, whose *Song of a Shirt* and *Bridge of Sighs* have touched, and will ever touch, all true hearts with sadness.

Bryant.—Among the conspicuous later poets are Bryant, Longfellow, and Tennyson. William Cullen Bryant (1794–1878) first commanded attention by a poem, *Thanatopsis*, written when he was nineteen years old—a grand monody upon the end appointed for all living, the inspiration of which was perhaps caught from a passage in *Measure for Measure*, and which has taken a place among the classic poems in the English language. After reaching the age of seventy years he made a translation of Homer which disputes the palm of superiority with all its predecessors. Between these periods of a laborious life he wrote not much poetry, but none unworthy of the fame he won so early and sustained so late. In purity of style, in the finish of his verse, in the elevation of his thought, and in his loving portraiture of nature he is unsurpassed among the poets of his time. His writings lead one to wish that poetry had been the business and not the mere adornment of his life.

Longfellow.—Henry Wadsworth Longfellow (1807–82) passed his life in the pursuits of the higher literature. His two earliest books, *Outre Mer* and *Hyperion*, were prose, but the prose was that of a man of poetical temperament. Then came the *Voices of the Night*, which at once commanded the attention of the whole English-speaking public, and have been translated into German and into other languages. He subsequently gave to the world many volumes of poetry which have enjoyed as great a popularity in Europe as in America. Longfellow's poetry has the rare quality of addressing itself directly to the minds and hearts of all men. High and low, educated and uneducated, all acknowledge its charm. Singularly refined in his every utterance, he became the most popular English poetical writer of his time. His poems are galleries of characters uttering sentiments that sink into the general heart. To his original works he added a translation of Dante, the singular fidelity of which to the original in thought and in form shows no less his mastery of his own tongue than his thorough and subtle knowledge of that of the great Florentine poet.

Tennyson.—Alfred Tennyson (1809–92), on succeeding Wordsworth as poet-laureate, took the first place among living British poets. In his case almost the poet was made, not born, for his first volume, published in 1830, gave no promise of his future fame; and it was not until twelve years afterward, when Longfellow had published his *Voices of the Night*, his *Ballads and Other Poems*, his *Poems on Slavery*, and had in press *The Spanish Student*, by which his style of versification and the character of his thought were fully displayed, that Tennyson published his third book, *English Idyls* (2 vols.), in which the *Morte d'Arthur* and *Locksley Hall* gave unmistakable indications of his genius. These facts dispose of the assertion, which has been unwarily made, that the New England poet was an imitator of his British contemporary, a somewhat younger man and a very considerably later poet. After the publication last mentioned, Tennyson's poetic faculty grew greatly, and with it his fame. Tennyson is eminently a poet whose powers were developed, almost made, by discipline and by culture. Like Wordsworth he held himself apart from the world, consecrating his life to his Muse. His style is elevated, pure, and deeply thoughtful. He deals with the great problems of the human soul—but incidentally, none of his works having a distinctly metaphysical or even a moral aim. His *In Memoriam* is in this way very characteristic of his mind, and with his *Idyls of the King* presents the highest manifestation of his powers. He ever wrote with a high aim, but always showed a consciousness that he was doing so. The deficiency of his poetry is in spontaneousness and energetic utterance. He rarely catches "a grace beyond the reach of art." But some of his lyric poems, like the one beginning "Break, break, break on thy cold gray stones, O Sea!" have an exquisite charm of sentiment.

Browning.—If the dramatic writing of his day were worthy of classification as literature, Robert Browning (1812–90) should be regarded as at the head of the dramatic poets. This place would be his, not so much by virtue of his plays as because all that he wrote is imbued with the purest and highest dramatic spirit. He is not only the greatest English dramatist of the age, but the greatest since Shakspeare. He had that power so admirable, so rare, of creating living personages whose characters become known to us not by description, but by their own actions and utterances. In these characters he entirely lost his own identity, and even, it would seem, his own consciousness. He thought their thoughts, and felt their feelings. This is true in what seem to be descriptive poems; and the well-chosen names of two of these volumes, *Men and Women* and *Dramatic Lyrics*, show a consciousness on his part of this power. His versification is often rough, his style careless, his thought involved; but those who understand him forgive these defects (which he sometimes compels into charms, if not into beauties) for the delight they take in his rare dramatic genius. He married Elizabeth Barrett (1806–61), the most eminent of English poetesses, whose *Portuguese Sonnets* (in which the love crowned by that marriage is covered by a very transparent veil) are admirable for fervor and freedom of utterance, and whose *Aurora Leigh* is in fact a novel of society wrought skillfully into a charming narrative poem.

Lowell.—James Russell Lowell (1819–91) and Matthew Arnold (1822–88) are uncommon exemplars of the union of the poetical and the critical faculty. No one can read Mr. Lowell's *Legend of Brittany*, his *Sir Launfal*, his *Commemoration Ode*, and his minor poems without wishing that he had given his life to the development and the perfection of the great natural poetic gift which they indicate. As a humorist he has few equals, and he is most widely known by the *Biglow Papers*, a series of humorous satirical poems in the rustic New England dialect, of which Lowell is a perfect master. His critical essays, especially those in *Among my Books* and *My Study Windows*, are marked by searching independence of thought and the fruits of a wide range of reading, enlivened by touches of his rare and racy humor. Of Matthew Arnold's poems, his dramatic *Sohrab and Rustum* is the finest exhibition of his power in this direction. It has the true antique grandeur, with the antique simplicity and directness. His essays and critical writings, which are numerous, are marked by unusual subtlety of thought and an exquisite finish of style.

Swinburne.—Algernon Charles Swinburne (b. 1837), the most prominent, if not the most admirable, of the younger English poets, first commanded attention by his drama, *Atalanta in Calydon*, remarkable for its exquisite fancy, its wealth of language, and its strong infusion of the old Greek spirit. His other dramatic poems, although not equal to this, delight admirers of strong passion and unreserved utterance. A volume of *Poems and Ballads* exhibits the same qualities in a greater degree, clothed in a versification the external richness and strength of which compel an admiration sometimes unwillingly given to such exhibitions of nakedness of soul and body.

Morris.—There are two kinds of nakedness: of soul, and of body; the purer kind never was seen in a more alluring form than in the poems of William Morris (1834–96), whose *Jason* and *Earthly Paradise* have placed him high in the second rank of English poets. Morris goes to the legends of ancient Greece and of the Middle Ages for his subjects; and he tells these old tales with such vividness of imagination, such picturesque and sensuous richness of description, and such sweet simplicity of feeling that he renews and freshens all their old beauty and adds to it a charm of his own. His versification is remarkable for its easy flow and for the luscious richness of its sound. But his great strength lies in his imagination. He sees before him the subject of his verse. As a narrative poet he has no superior or equal but Chaucer, of whom he professes himself the scholar.

Whittier.—Of the poets of minor fame John Greenleaf Whittier (1807–92) produced some fine examples of true ballad poetry—high praise, for the true ballad, one of the most charming forms of lyric composition, is in modern days among the rarest of poetical productions; and the author of *Barclay of Ury*, *Maud Muller*, and *Barbara Frietchie*, always pure, fervid, and direct, will be remembered when many a more voluminous and ambitious writer is forgotten. Mention should also be made of Thomas Williams Parsons (1819–92), the master of a true and strong poetic utterance; Jean Ingelow; Bret Harte, whose humorous poems in dialect have qualities regarded as peculiarly "American"; Bayard Taylor (1825–78), who has made the best translation of *Faust*; Richard Henry Stoddard, George Henry Boker (1842–90), Edmund Clarence Stedman, and Walt Whitman (1819–92), who amid heaps of commonplace rubbish in fantastic form has dropped some lines weighted with thought and true feeling.

The principal dramatists of the nineteenth century are James Sheridan Knowles (1784–1862), Dion Boucicault (1822–90), Tom Taylor (1817–80), and Thomas William Robertson (1829–71), but no one of them wrote a play which has any value except upon the stage. In the English language dramatic literature seems to have ceased to exist. Richard Brinsley Sheridan (1751–1816), the author of *The Rivals* and *The School for Scandal*, belonging partly to the eighteenth century, is the last of the dramatic school. But even his comedies are comedies of wit, not of character, and the wit is always that of Sheridan, not of the personages who utter it.

Novels.—In no department of literature has the increased intellectual activity of the nineteenth century been so copiously manifested as in that of prose fiction. The writers of novels are to be numbered nowadays by the hundred. Merely mentioning the names of Hannah More (1745–1833), the author of *Cœlebs in Search of a Wife* and other writings of a pietistic-social purpose; William Beckford (1759–1844), whose *Vathek*, originally written in French, does not for its merit deserve a notable place in English literature; Anne Radcliffe (1764–1823) and Matthew Gregory Lewis (1775–1818) (called "Monk" Lewis, from the title of his most celebrated work), both of whom reveled in horrors and mysteries; and the two sisters, Jane (1776–1850) and Anna Maria Porter (1780–1832), the priestesses of the goddess of sensibility—all of whom belong rather in spirit, as they do much in time, to the eighteenth century—let us pass to the consideration of the later and stronger writers of fiction, only the most eminent and characteristic of whom can be noticed here.

Scott.—The great novelist of the century, of the English language—and it is not too much to say of the world—is Sir Walter Scott, who, as has been seen, holds also so high a place among its poets. *The Waverley Novels*, so called from the title of the first one of the series, are chiefly historical—that is, their plots are interwoven with historical incidents, and some of their principal personages are figures taken from history. In correctness of historical detail, as also in correctness of style, they are open to adverse criticism. But trifles of that kind are, or ought to be, disregarded by even the best-informed and most cultivated readers as they are borne onward upon the strong, steady stream of the story. Scott was simply the greatest writer of stories that ever lived. His imaginative realization of his personages, and his dramatic evolution of their characters and management of their intercourse with each other are inferior only to Shakspeare's, from whom, in imaginative writing, criticism may take one great leap to him. No other writer but Shakspeare has filled the world's memory with such a throng of living figures, so varied in their types, so lifelike and real-seeming in their action. He spends little time in analyzing motives and in dissecting character; but with strong, clear touches, every one of which has meaning, he places the man or the woman before us, and we know them, as we know our friends or our enemies, forever after, and at once we become interested in their feelings, their actions, their experience, and their fate. Scott is a singularly healthful writer. There is in his works hardly a morbid passage or one in any sense injurious. One rises from them refreshed, delighted, invigorated, elevated. In narrative power, in truthfulness, in picturesqueness, in life-like action, in the clear management of a complicated action, in united strength and delicacy of portraiture, in grandeur of movement, in humor, and in charm of style he is without a rival. Jane Austen (1775–1817), who followed him as a younger contemporary, is one of the best of English domestic novelists. Her works will always be read for their intrinsic interest and as faithful and pleasing pictures of the society of her time. George P. R. James (1801–60) was an imitator of Scott, and although a prolific writer and a favorite with the public of his day, he has shared the fate of all imitators, and is now little read. But the author of *Philip Augustus* and *One in a Thousand* was a novelist of no mean powers.

Bulwer.—Edward Lytton Bulwer (1803–73), afterward Lord Lytton, in his novel *Pelham* introduced to the world what is distinctively known as the novel of fashionable society. He afterward extended his field and wrote historical novels, sentimental novels, novels descript and nondescript. A man of high culture, of various acquirements, and a writer of considerable power, he commanded for many years the admiration of a wide circle of readers. But he was in no way original; his sentiment was equally false and excessive; his style was artificial; he had no dramatic power; and his personages have no true life or character, but are bundles of clothes with something in them that talks what Edward Bulwer thought. No one of them lives except Pelham, a typical high-class dandy of the latest Georgian era. His best works are *The Caxtons* and *My Novel*, written in imitation of Sterne.

Disraeli.—Benjamin Disraeli (1804–81)—the son of Isaac Disraeli (1766–1848), a Hebrew who was converted to Christianity, and who is widely known as the author of *The Curiosities of Literature*, *The Amenities of Literature*, and *The Calamities of Authors*—was the author of several novels, the earliest of which is *Vivian Grey* (1825) and the last *Endymion* (1880). His works are brilliant, and have always commanded attention, but they are fantastic, extravagant, and untruthful as representations of human nature or of society at any time or in any country. Most of them have a political or a social purpose, and are believed to contain portraits of contemporary politicians and other persons of distinction. But *Henrietta Temple* has been regarded by some critics as one of the most natural love-stories ever written. His writings indicate a strong prepossession in favor of the Hebrew race. His chief distinction was in the field of politics.

Dickens.—Charles Dickens (1812–70), a man of singularly original powers, next appeared upon this field. He was a humorist, and found congenial subjects among characters of low, or at least of humble, life. Of these his caricatures—for he rarely drew except to caricature—are infinitely amusing. His attempts to rise above this plane were, with one notable exception, *The Tale of Two Cities*, conspicuous failures. His sentiment is generally exaggerated, and his pathos often false. But as a humorist, pure and simple, he is unrivaled in the present generation. William Makepeace Thackeray (1811–62), also a humorist, was a writer of a very different stamp. His novels are satires upon society. But his style is pure, his satire delicate, his caricature little exaggerated, and his pathos is true and often profound. His personages generally belong to the cultivated classes of society, and his representations of gentlemen and ladies, both as to their manners and their motives, are always worthy of admiration. The author of *Vanity Fair*, *Pendennis*, and *Henry Esmond* has a high and a permanent place among English writers of fiction. Charles Kingsley (1819–75) was the author of novels of very considerable merit, among which are *Alton Locke*, *Yeast*, and *Amyas Leigh*.

George Eliot.—Among women who have written novels, Charlotte Brontë (1816–55), the author of *Jane Eyre*, holds a conspicuous place. Her few works are chiefly remarkable as giving, with great subtlety of perception and boldness of utterance, the woman-view of man's character, and as to women their view of themselves in relation to man. Very introspective and analytic, they dissect motives with a hand at once bold and delicate. In this respect, however, as in all others, she must yield to the writer who appeared under the name of George Eliot, but whose real name was Mary Ann Evans (1819–80). George Eliot's constructive power was small; she was not a great teller of tales. In her subtle analysis of character and revelation of motives she allowed the movement of her story to lag: she crowded her canvas with too many figures, all painted like miniatures, until she and the reader both began to forget the main purpose in hand. To this criticism, however, her earlier sketches, her first novel, *Adam Bede*, and above all *Romola*, are in a great measure exceptions. *Romola*, as the history of two lives, and in the revelation of character and the motives—the unacknowledged and almost self-unknown motives—of its principal male character, Tito—is a marvelous work of art. George Eliot, like the generality of female writers, was most successful in describing what she had seen. Her personages are studies from life, but she had a vivid imagination and great dramatic power. Her views of life and of human nature are gloomy and depressing. Her style is in all respects admirable. Elizabeth (Stevenson) Gaskell (1810–65) must not be forgotten, her *Life of Charlotte Brontë* and her works of fiction, such as *Mary Barton* and *Cranford*, possessing rare merit.

Reade.—Charles Reade (1814–84) wrote novels which by their vividness of portraiture, their vivacity of movement, and their humor took a firm hold upon the public. Whatever the nicely fastidious may think of the taste of much that he wrote, even they can not fail to be interested in the fortunes of his personages. His effects are theatrical, and sometimes seem as if they were contrived for the stage. He leaves little impression of reserved power. His best works are *Christie Johnstone*, *Peg Woffington*, and *The Cloister and the Hearth*; the last an historical novel which needed only condensation to have taken a high place among works of that class.

Writers of Fiction in the U. S.—To prose fiction the U. S. has contributed little of a very high order. In the eighteenth century, Charles Brockden Brown (1771–1810) wrote several novels which have some power of enlisting the attention, but the morbid tone of which made them repulsive, and they have been wisely allowed to pass into oblivion. James Fenimore Cooper (1789–1851) attained a greater and more enduring celebrity. This was chiefly, however, because his scenes depicted frontier life, that of hunters, trappers, and Indians. They pleased those whose taste delighted in adventure, and in Europe they commanded attention because they were regarded as peculiarly "American." As tales of adventure they are interesting to those who are not fastidious as to the truthful seeming of what they read; but they have no value as studies or pictures of human nature. The characters are impossible, and the style is poor, mean, and unpolished. They are chiefly adapted to the tastes of very young men and boys. Cooper's sea novels are of greater merit, if not of a higher order.

Hawthorne.—After Cooper there was no novelist worthy of special notice until the appearance of Nathaniel Hawthorne (1804–64), whose *Scarlet Letter* at once commanded the admiration of the whole literary world. Hawthorne was a writer of the most marked originality and at the same time of the highest finish in style. His novels are highly dramatic; but their dramatic power is as unlike that of Scott's, for instance, as can be. He deals with the inner life of his personages. We see them indeed, but chiefly we live their lives. His death cut short what promised to be a brilliant career, but he left enough behind him to secure an enduring fame. Edgar Allan Poe (1809–49) produced no novel, but as a writer of tales, the strange incidents of which he had the singular power of making seem not only probable but actual and real, he attained distinction at home and abroad. He writes like a gifted reporter of extraordinary and incredible scenes which pass before his eyes. With him it is difficult to draw the line where the possible ends and the impossible begins. His fanciful poems and his trenchant criticisms added to his reputation, but he does not take a place among those who have nature as a model. Probably no other modern work of fiction has been so widely read as *Uncle Tom's Cabin*, by Mrs. Harriet Beecher Stowe (1812–96); but the interest which it excited was due chiefly to the sensitiveness of the public mind all over the world upon the subject of slavery in the U. S. Mrs. Stowe's other novels, although superior to that which made her known, failed to receive anything like equal marks of public favor.

Trollope.—The novel of modern society has attained what would seem to be its highest development in the voluminous works of Anthony Trollope (1815–82). His discernment of character was subtle and true; his appreciation of social relations and of their effects upon external and internal life has never been equaled, and it would seem can not be surpassed, because it is perfect. He is not specially humorous, or satirical, or sentimental, or sensational; and yet humor and satire and sentiment and sensation all appear in his novels, simply by their being so true a reflex of individual and social life. If his stories are ever tame and commonplace, it is because society is tame and commonplace; and their many characters which are noble, and their many passages which are colored with the warm hues of strong or tender feeling, show that all that is artificial and conventional in modern society does not repress, but sometimes tends even to heighten and to quicken, the emotions of unchanging human nature. In the completest contrast to the novels of this author are the vivid and picturesque sketches of California life, in prose and verse, of Francis Bret Harte (b. 1831), who rapidly attained the reputation of being the first writer of fiction whose works are marked by a peculiarly "American" tone and atmosphere; and possibly there may be something in them of this kind which is not due only to their characters and the social conditions which they represent. However this may be, their interest is peculiar and their humor delicious.

Hughes.—Thomas Hughes (1823–96) became celebrated as the author of *Tom Brown's Schooldays* and *Tom Brown at Oxford*, written for very young readers; but, like all good books of that kind, they were full of interest for those of riper years. The manliness of style and tone in these books, their sound morals, far removed from all priggish pretension to goodness, and the thorough understanding of boy nature which they show, have made them classics in their kind. Charles William Shirley Brooks (1816–74) should be mentioned as a society novelist of very considerable powers, and William Wilkie Collins (1824–89) as the author of tales remarkable for their intricate and well-contrived but not very probable plots.

Among the crowd of novelists of the day whose very names can not be mentioned except in their aggregate form of legion, that of George Meredith (b. 1828), author of

The Ordeal of Richard Feverel, Beauchamp's Career, and other works, takes high rank for vigor and individuality, though unknown to the general reader. Richard Doddridge Blackmore (b. 1825) has produced one book (*Lorna Doone*) that has become a classic. Walter Besant (b. 1838) has dealt with social problems in many of his novels—in *All Sorts and Conditions of Men*, for instance—and given a decided impetus to the work of social reform. John Henry Shorthouse (b. 1834), the author of *John Inglesant*; William Black (1840–98), the author of *A Princess of Thule*; and J. M. Barrie (b. 1860), the author of *The Little Minister*, men differing widely in style, have acquired great popularity.

Hardy.—Thomas Hardy (b. 1840), the author of *The Return of the Native, The Hand of Ethelberta, Tess*, and a number of other stories, is one of the most original of English novelists. His plots are distinguished by piquant situations, the talk of his rustics has the quaintness of Shakspeare's simple folk, and his heroines are fallible but charming. The most vivid and truthful presentation of social life in the U. S. in the center of its wealth and commerce that has yet appeared is *Never Again*, by William Starbuck Mayo, M. D. (1812–95). George William Curtis (1824–92) also wrote one novel, *Trumps*, but he will rather be remembered as the author of *Prue and I*, a series of confessions of a simple-minded old bookkeeper of exquisite tenderness and sweetness of sentiment, and of the *Potiphar Papers*, a burlesque of New York society, and of the *Howadji* travels, in the style of Kinglake's *Eothen*. The latest school of society fiction is represented in America by William Dean Howells (b. 1837), author, of *A Chance Acquaintance, A Modern Instance, The Rise of Silas Lapham*, etc.; and Henry James, Jr. (b. 1843), author of *Daisy Miller, The Europeans, The Bostonians*, etc. Both of these novelists are subtly analytic in method, dealing largely in manners and in delicate shades of character, and discarding the old-fashioned "plot." They have originated "international" fiction, in which the opposing ideals of American and foreign society are brought into amusing contrast. In their minuteness of observation and truth of detail they sometimes resemble Trollope, though their literary principles ally them more closely to recent continental fiction than to the English.

Essayists and Miscellaneous Writers.—Few tasks are more difficult than the classification of books and their writers. Where shall be placed William Cobbett (1762–1835), who wrote upon politics, gardening, and what not? It is chiefly as a political essayist, however, that he will be remembered. His writings show strong common sense, strong prejudices, independence of thought, set forth in a direct, manly, incisive style. William Godwin (1756–1836) wrote a novel, *Caleb Williams*, the fame of which still lives, but his chief distinction was that of a political essayist and historian of robust mind and strong liberal tendencies. His wife, Mary Wollstonecraft (1759–97), by her *Vindication of the Rights of Woman*, took the lead in a movement which seems to be still advancing. Charles Lamb (1775–1836) will be always read, and always loved, for the gentleness of soul and the exquisite humor, sometimes falling into mere personal whim, which appear in his *Essays of Elia* and his correspondence. To him there could not be a stronger contrast than Walter Savage Landor (1775–1864), who had all the virtues and most of the faults peculiar to the Anglo-Saxon race, and embodied them in his writings, although his peculiarities of temper kept him so at war with his kindred, and even his country, that he passed most of his life in voluntary exile. His *Pericles and Aspasia, Imaginary Conversations, Last Fruit off an Old Tree*, and *Dry Sticks* show a wide range of learning and strong critical sense, but narrow sympathies, and an absence of that great lubricator of the friction of life—humor. John Wilson (1785–1854), although he wrote some poetry, is remembered for his *Christopher North* papers upon literature and sporting subjects, which were published in *Blackwood's Magazine*, of which in its earlier years he was editor. His critical taste was sound, but much of his writing is mere animal spirits put on paper, and he was chief of a school all of whose pages reek with the fumes of whisky and tobacco, which can not, however, entirely becloud their strong sense and their scholarship.

De Quincey.—For whisky and tobacco Thomas De Quincey (1785–1859) substituted opium, to which we owe his *Confessions of an Opium-Eater*, and perhaps its effects may be traced in *Suspiria de Profundis* and in many of his subsequent voluminous writings, which are crowded with the evidences of a wide range of desultory scholarship, with subtle criticism, rich fancy, and a peculiar humor, all embodied in a style of remarkable richness and splendor. William Hazlitt (1778–1830) lived from early manhood until his death, not very happily, upon the miscellaneous products of his pen as a contributor to various periodical publications of his day. He was consequently able to do little as we may be sure he would have liked and was able to do it. But as a critic of literature and art and of society he holds a high place, which he owes in a great measure to his manly and thoroughly English style. James Henry Leigh Hunt (1784–1859), another writer of the same sort, has less force, but is always graceful and pleasing. But the great modern master in English of grace and ease, and of a lambent humor much like that of Addison, is Washington Irving (1783–1859), whose *Sketch Book, Knickerbocker's History of New York*, and *Legends of Sleepy Hollow* do more to secure his enduring fame than most of his more ambitious works, including his *Life of George Washington.*

Carlyle.—Unlike Irving in every way was Thomas Carlyle (1795–1881), whose style is rugged and whose humor grim, but who was a critic of the first class, and whose *Sartor Resartus* is a subsoil plow driving deep beneath the surface conventionalities of society. A like purpose prevails in his *Latter-Day Pamphlets* and *Hero-Worship.* It is to be remarked that Carlyle's peculiar style—so peculiar that it has been called "Carlylese"—does not appear in his earlier works. Mr. Carlyle the reformer appears as a scornful, scourging critic, and in that spirit he wrote his historical works, *The French Revolution* and *Frederick the Great.* To him Ralph Waldo Emerson (1803–82) has been not very happily compared. The purpose of the two writers may be the same, but their manner is entirely different. Emerson had the calm observance and the serene thoughtfulness of a philosopher, and he showed a strong love of external nature of which Carlyle seemed scarcely conscious. His style is aphoristic and epigrammatic, and both his prose and his poetry are full of wisdom. Caroline Elizabeth Norton (1808–77), a miscellaneous writer, inherited some of the talent of her grandfather, the great Sheridan.

Smith and Jerrold.—Among the wits of a past generation two were pre-eminent—Sydney Smith (1771–1845) and Douglas Jerrold (1803–57), but their wit was almost their only point of likeness. Jerrold's wit was a scourge, while Sydney Smith's was the genial laughter of a lover of his kind. His essays touch many of the most important topics in which men of these times are interested, and they are loaded with sagacity. His style is remarkable for its clearness and manly dignity. Another wit whose wisdom is greater than his wit is Oliver Wendell Holmes, M. D. (1809–94), of whose writings his *Breakfast-Table* books—the *Autocrat*, the *Poet*, and the *Professor*—exhibit his mind and his style at their best. They present a curious and careful study of that variety of human nature which is found in the New England of the nineteenth century, and are threaded through and through with gentle satire. The study of human follies and human weakness and of the conventional forms of modern society which took Holmes to the breakfast-table and Sydney Smith to the dinner-table, drove Henry David Thoreau (1827–62) to a hermit's life, in which he lived in a cabin of his own building, chiefly upon beans of his own growing. He studied birds and beasts and inanimate objects for the purpose of reflecting severely upon man. But his love of nature was genuine, his love and knowledge of literature great, and his own style beautiful. He can not be read without forgiveness for his gentle mistaken misanthropy.

Helps.—Arthur Helps (1813–75) won for himself a peculiar, and, if not a very high, a long-enduring place in literature. With little that is strikingly new in his thought, he commands the respectful attention of a large circle of the very highest class of readers. This he does by the very clear and earnest way in which he brings up and presses home half-forgotten truths which concern the daily life of all cultivated people. He presented homely common sense in the most elegant dress. He wrote two novels, *Realmah*, over which his Friends in Council entertain themselves and his readers with wise and witty chat, and *Ivan de Biron.* Among other writers of this class in America even such a sketch as this must notice Donald Grant Mitchell (b. 1822), a polished satirist of society and an observant critic of rural life; Thomas Wentworth Higginson (b. 1823), whose essays are strong protests against physical and mental weakness;

and Edward Everett Hale (b. 1822), whose sermons, essays, and sketches all show a strong, clear, subtle mind, a lover of freedom, and a Christian of the Broad Church.

A peculiarly national type of low or broad comic writing has been developed in the U. S., the two foremost representatives of which are Charles Farrar Brown, "Artemus Ward" (1834–67), and Samuel Langhorne Clemens, "Mark Twain" (b. 1835), the author of *Innocents Abroad*, *Adventures of Huckleberry Finn*, etc. These humorists and their numerous imitators have made free use of dialect, slang, cacography, and similar devices, and their fun is tinctured with extravagance, irreverence, caricature, and the wildest paradox. It is, however, unquestionably effective, and is a new thing in the humorous literature of the world.

Criticisms of the arts of design, like those arts themselves, sprang up late, and at first grew feebly, among the English-speaking peoples. The *Analysis of Beauty* of William Hogarth (1697–1764) and the *Lectures* of Sir Joshua Reynolds (1723–92), although not without suggestions of some value, are chiefly distinguished as the works of eminent painters. And Burke's *Essay on the Sublime and Beautiful* is all awry from its purpose. Its very style lacks all its author's peculiar charm. Rev. Archibald Alison (1757–1839) wrote *Essays on Taste* which promoted culture in this respect, but which are now rarely referred to; but Sir Uvedale Price's *Essays on the Picturesque*, published in 1810, may still be read with profit, and have since been reprinted. The works upon Christian art by Mrs. Anna Jameson (1794–1860) contain much that is valuable, both of history and criticism.

Ruskin.—It was not until the appearance of John Ruskin (b. 1819) that there arose a subtle, profound, and thoroughly qualified critic of fine art—one who to his critical perceptions joined the ability to communicate them with beauty and impressiveness of style. Mr. Ruskin's chief distinction as a critic is that he never writes without making his hearers think, even when they smile at his utopian theories of society and of political economy. James Jackson Jarves (1818–88) has written with knowledge, thoughtfulness, and honesty about art, and particularly ancient art; and Philip Gilbert Hamerton (1834–94) displayed the same qualities in *Etching and Etchers*, *The Graphic Arts*, and other important works.

Criticism has been raised to a special branch of literature during the nineteenth century, toward which the establishment of the great British periodicals, the *Edinburgh Review*, the London *Quarterly Review*, the *Westminster Review*, and in the U. S. the *North American Review*, contributed largely; their influence and example have been such that now no magazine or newspaper of the first class, either in Great Britain or North America, appears without such critical reviews of literature in all its branches, of art, and of science, as fifty years ago were produced nowhere, and which, with allowance for much ignorance, presumption, and bad taste, on the whole guide the public mind aright. In this department of literature many of the writers who have already been mentioned attained distinction.

Of those not hitherto mentioned, Lord Francis Jeffrey (1773–1850), William Gifford (1756–1826), and John Gibson Lockhart (1794–1854) deserve special mention. They were all severe, as well as able and generally honest, in their criticism, and did much toward the formation of the public taste in the early part of the century. Henry Hallam (1777–1859) in his *Literature of Europe* gives a mass of various learning and generally sound critical opinion. It is, and will probably remain, the standard work upon its subject in the English language.

Philology, using the word in its widest sense, includes all writing upon language, even the well-known grammar of Lindley Murray (1745–1826), the American Quaker who for so long gave the law of the construction of their language to English-speaking people. But comparative philology, which alone is worthy of the latter half of its name, is the product of the nineteenth century, and had its rise in the discovery and study of the Sanskrit language, the oldest known representative of the speech of the Aryan or Indo-European peoples. This discovery, which is due to Sir William Jones (1746–94), established a connection between the modern world and that of prehistoric times, and revealed the bond which binds together all the Indo-European peoples. But before this discovery an analytic philologist (or etymologist) of great ability, John Horne Tooke (1736–1812), had appeared in England. His *Diversions of Purley*, although not without errors, is a monument to his learning, sagacity, and fine linguistic sense. Joseph Bosworth (1788–1876) investigated the field of Teutonic and Scandinavian languages; George Perkins Marsh (1801–82) philosophically recorded the growth of the English language and its literature; Robert Gordon Latham (1812–88), with a profound and vast range of knowledge, developed theories of ethnological philology, dissected the English language, wrote its grammar on philological principles, and completed an English dictionary based upon Johnson's. William Dwight Whitney (1827–94) pushed his investigations of the Oriental languages and of the wide field of the higher philology to what seems almost the verge of attainable knowledge; James Hadley (1821–72) has shown that he might have been his rival; Max (Frederick Maximilian) Müller (b. 1827) has delighted and stimulated all students of philology by his brilliant generalizations in the "science of language" in its broadest sense; March has produced his great Anglo-Saxon grammar; and Trench and Farrar and Garnett and Helfenstein and Craik and Skeat and Child have distinguished themselves by works of narrower scope, but hardly of less interest. The Early English Text Society, under the management of the able and indefatigable Frederick James Furnivall (b. 1825), has published a great mass of well-edited English writing of the twelfth, thirteenth, and fourteenth centuries, and made accessible to eager students materials which they are using for the elucidation of the philology of their mother tongue.

History.—In no department of literature has a greater change been manifest during the nineteenth century, both in form and in spirit, than in history. This change—the result of the combined influences of the comparative system introduced by Niebuhr, of the strong tendency toward a positive or scientific treatment in all branches of intellectual endeavor which rest in any way upon facts, and of the increased appreciation of the value of the minutest matters of record which show the intellectual, moral, and social condition of a whole people, the middle and lower, as well as the noble and educated classes—has caused the historians of the modern school to extend their researches, to enlarge their plans, and to endeavor to portray upon a vast field not only the great vicissitudes of nations and the eminent individuals who controlled or seemed to control them, but the whole political, moral, and social life of the people and the periods whose stories they undertake to tell. Hence histories are now at once more fragmentary and more minute than they were of old.

English History.—Dr. John Lingard (1771–1851) wrote a history of England down to the abdication of James II., which is valuable for its research, the mass of facts accumulated, its calm tone, and its skillful arrangement. But it was written from the Romanist point of view, with a Romanist purpose; and its value is seriously impaired by its skillful perversions and suppressions of fact. The *History of the Anglo-Saxons and of England during the Middle Ages* of Sharon Turner (1768–1847) is the only thorough and systematic presentation of its subject in the English language. Trustworthy as to fact, it is deformed by an ambitious, involved, un-English style. Lord Mahon (Earl Stanhope, 1805–75) must be mentioned as the faithful and thoughtful, although somewhat spiritless, historian of England from 1718 to 1783. Sir James Mackintosh (1765–1832), who failed to do all that his unquestioned abilities gave reason to expect, produced a compact *History of England* (3 vols., Lardner's *Cyclopædia*), remarkable for a clear and philosophical treatment of political and constitutional questions.

Hallam.—The great constitutional historian of England is Henry Hallam (before mentioned). He is thorough, candid, and, although liberal in tendency, judicially calm, as becomes his subject. His *History of Europe during the Middle Ages* has the same qualities, but lacks picturesqueness of presentation. The subject of the constitutional history of England has been ably continued by Sir Thomas Erskine May (1815–86). Sir Archibald Alison (1792–1867) was the author of a *History of England* from the beginning of the French Revolution to the restoration of the Bourbons, which has the great value due to an industrious collection and systematic arrangement of facts by an almost contemporary writer. But it is diffuse, prolix, and deformed by a style both pretentious and ungraceful. It is best read in his own abridgment of it.

Macaulay.—Thomas Babington Macaulay (1800–59) produced, in his *History of England from the Accession of James II.*, the most striking and picturesque historical work of the century. Written with strong partisan prejudices, if not with a partisan purpose, it is filled with masses of moral light and shade, and must be read with corresponding allowance as to facts and its representation of individuals. But in its grouping of facts, in its pictures of social life, and in the splendor and the graceful ease of its style, it is without a rival in English literature. The research upon which it was founded and the minuteness of its picture-painting made it impossible for the author to bring it down, as he had intended, to a period within the memory of living men. Its five octavo volumes cover a period of only fifteen years. With its author's essays upon the characters of Bacon, Milton, Addison, Walpole, Johnson, Byron, and Hastings, it forms a body of historical writing of almost unequaled splendor and interest. James Anthony Froude (1818–94) produced a very valuable history of England during the times of the Reformation. His investigations led him to take new views of the character of Henry VIII. and of that of Elizabeth, which the authorities quoted by him seem to support; but upon the much-vexed question as to the characters of Mary of Scotland and Mary of England he ranges himself at the head of their condemners. On the history of Ireland he has also written vigorously, and after much original research. Edward Augustus Freeman (1823-92) is the author of a *History of the Norman Conquest* written from an entirely new point of view, in which he presents a philosophical appreciation of the causes which led to the invasion, of the condition of insular and continental society at that period, and of the social and political consequences of the conquest. Its great merit gave him at once a high position in historical literature. The various biographical works of Mr. John Forster (1812–76) have so marked an historical bearing that he deserves honorable mention as a writer in this department.

Continental history has been illustrated by two English writers of eminent ability. Thomas Carlyle's *History of the French Revolution* is rather an expression of the spirit of the time of that great event than a record of its facts, a knowledge of which is almost assumed by the writer. But it is perhaps the most complete and characteristic manifestation of its author's peculiar genius. His *History of Frederick the Great* is truly historical, and presents new results of original research. It is written in "Carlylese," and is full of fantastic and grimly humorous passages, but its truly historical value is nevertheless very great. John Lothrop Motley (1814–77) has taken the highest position as the historian of the Netherlands and the Dutch Republic. To the results of patient research and logical analysis he added the attraction of a fervid style and an enthusiastic love of his subject.

Bancroft.—The history of the United States was written by George Bancroft (1800–91) with a minuteness of detail which often produces the impression that he looked at small and commonplace occurrences through the glorifying medium of their consequences. His style may also be regarded as often too ambitious for the subject immediately in hand. But as a whole his work is worthy of the admiration it has received and of the authoritative position it has attained. Richard Hildreth (1807–65) wrote his *History of the United States* in a style directly opposite. It is cold, dry, unpicturesque, and rigidly judicial. But as a clear and well-connected record of facts it is of great value, and may be safely relied upon. James Parton (1822–91) produced several biographies of eminent citizens of the U. S. which have an historical purpose and value. John Gorham Palfrey (1796–1881) wrote a *History of New England* in a most interesting and impartial manner, and John Fiske (b. 1842) has further enriched the history of the Colonial and Revolutionary periods of the same section. Francis Parkman (1823–93) has given us in numerous volumes the history of the French explorations and settlements in North America. His pictures of Indian life and wilderness scenery have wonderful vividness and a romantic interest not inferior to the fictitious adventures of Cooper's backwoodsmen.

Prescott.—Spanish and Spanish-American history has been illustrated by William Hickling Prescott (1796–1859), perhaps the most charming of all English historical writers, and inferior to none in patient research. His histories of Ferdinand and Isabella, of Philip II., and of the conquest of Mexico and the conquest of Peru, are a most fascinating series of works. Arthur Helps (1813–75) wrote a *History of Slavery*, which, animated by a thoroughly humane and loftily philanthropic spirit, presents his subject with his characteristic calmness and reserve.

The history of Greece was written by William Mitford (1744–1827) with learning and the feeling of a true scholar for his great theme; Bishop Thirlwall (1797–1875) also produced a valuable history of the Hellenic peoples; but the work which displaces all others in English literature upon this subject is that of George Grote (1794–1871), who seems to have penetrated the very heart of Greek life, political, social, moral, and intellectual. His *History of Greece* and his *Plato* seem to present all that one can hope to know of the national experience and the best intellectual period of the great people who were the sources of modern civilization.

Arnold.—Roman history to the end of the Second Punic war was treated by Thomas Arnold (1795–1842), a worthy disciple of Niebuhr, who added a certain simple English tone and charm to the manner of his master. His *Lectures on Modern History* are also admirable in the same way. Charles Merivale (1808–93) wrote a *History of the Romans under the Empire*, which supplements acceptably Arnold's more vigorous work. Henry Hart Milman (1791–1868), a poet and the author of *Fazio*, a powerful and successful tragedy, wrote a *History of the Jews*, a *History of Greek Christianity*, and a *History of Latin Christianity*, which form an admirable trilogy of religious history.

Of war histories, the two most important are the *Fifteen Decisive Battles of the World* of Sir Edward Shepherd Creasy (1812–78) in which the author treats only of such battles as have had a manifest effect upon the course of civilization; and the *History of the Crimean War* by Alexander William Kinglake (1811–91), which as to fact is a clear result of careful investigation, but which in spirit is a fierce impeachment of the Emperor Louis Napoleon. Perhaps the volume of William Howard Russell (the well-known London *Times* correspondent) upon the same subject should here be mentioned. Of the histories of the civil war in the U. S. a few are of value; but most of them have been written by partisans living too near the events which they describe.

Buckle.—An entirely new kind of historical writing has been produced by the speculative spirit of the age. It is the history, not of nations or of men, but of man. Pre-eminent in this department is the *History of Civilization*, left unfinished by Henry Thomas Buckle (1821–62), who sought, with an admirable if not a perfect measure of success, to discover and describe the successive evolution of the moral influences which brought about the changes in the course of the history of the modern world. Of a like kind are the *History of Rationalism* and the *History of European Morals* written by William Lecky (b. 1838)—works which to a certain extent pluck out the heart of the mystery of man's moral nature and social life. And historians who deal with mere external facts now go beyond the historical period, and we have in such books as *Prehistoric Times* and *The Origin of Civilization*, by Sir John Lubbock (b. 1834), and *Prehistoric Man*, by Daniel Wilson (1816–92), ingenious attempts, marvelously successful to a certain point, in reconstructing the physical life of man at those dimly remote periods of which there is neither record nor tradition.

Books of travel are so considerable an element of modern literature, whether regarded as a means of literary entertainment or in their more important function of diffusing a knowledge of mankind and enabling us to study it under different climes and different forms and degrees of civilization, that they can not properly be passed over even in the briefest compendium of literary history. But so vast has been their number that only those can be noticed here which have some peculiar literary excellence, or which mark a period, or which have exercised some notable influence upon opinion.

Ledyard.—John Ledyard (1751–88) belongs in time to the eighteenth century, but he is noticeable as being the first of that series of travelers who set out with a purpose of establishing, verifying, or illustrating some cosmical fact—who are discoverers, not of new countries, but of the geographical relations and topographical condition of countries already known. Ledyard was the first of those travelers who have set out with the purpose of examining the Polar regions, and ended his life in Africa after making an unsuccessful attempt to discover the source of the Niger. Among the many British travelers who have described, or professed to describe, the condition and the character of the people of the U. S., Frances Trollope (1780–1863) did more than any other to form the opinion upon that subject which long prevailed in Europe. She was a keen observer, wrote in a clear and very pleasing style, and many of her most damaging assertions were literally true. But she entered the country at its then wildest and most uncultivated parts, the frontier towns of the Southern and the Western States, and did not become acquainted with the society which two centuries had developed in America until she was about leaving the country; and of this she said little. She thus produced a very amusing book and created a very erroneous impression, which the passage of a century will hardly obliterate. Another woman, Harriet Martineau (1802–76), of masculine traits of mind, treated the same subject in an entirely different spirit, and after careful and candid study produced in her *Society in America* a somewhat successful attempt at a calm and philosophical appreciation of the people of the U. S. and their political institutions. It will always be valuable as a record and an analysis of the facts and the spirit of life in the U. S. at the time when it was written.

Of Eastern travelers the most conspicuous are Eliot Bartholomew George Warburton (1810–52), the author of some novels, whose studies of Oriental life were embodied in *The Crescent and the Cross*; Sir Austin Henry Layard (1817–94), whose series of works giving the results of his excavations and investigations of the ruins of Nineveh are the most valuable contribution to the antiquarian and art history of the East ever made by an Englishman; and Alexander William Kinglake (1809–91), whose *Eothen* tells with such a wonderfully picturesque power the impressions which Oriental landscape, life, and manners make upon a civilized Christian from the West, and which has justly been called the most charming book of travel ever written.

Livingstone.—Africa and its geographical mysteries, particularly that of the source of the Nile, gave to Ledyard not a few followers. Among these are David Livingstone (1813–73), who penetrated to the heart of the country, crossing it twice at about 10° S. lat., traversing vast regions before wholly unknown to civilized man, and making geographical discoveries of very great importance; and Sir Samuel White Baker (1821–93), who followed the wonderful river up to a great lake which is one of its two principal reservoirs, and which he named the Albert N'yanza. The records of their toils, exposures, perils, observations, and discoveries by these two distinguished explorers have an interest which reaches the degree of fascination, and takes them to a certain extent out of the regions of geographical science into that of general literature.

The latest and not least brilliant chapter in the history of African discovery is furnished in the writings of Henry Moreland Stanley (b. 1840), who was detailed by the New York *Herald* in 1871 to find Dr. Livingstone; afterward explored the Congo and founded the Congo Free State, and in 1887–89 conducted a successful expedition for the relief of Emin Pasha.

Kane.—In the interest of his contribution to the literature of exploration, if not in the value of his discoveries, Elisha Kent Kane (1820–57) is eminent among those for whom the North Pole and a possible northwest passage from the Atlantic to the Pacific has had an irresistible attraction. His narrative of his experience in this region of icy blankness has the interest of romance with the stamp of literal truth, not surpassed even by the fiction of Defoe's *Robinson Crusoe*.

Conspicuous among American explorers, both in regard to antiquities and geography, is Ephraim George Squier (1821–88), whose works upon the mounds of the Mississippi valley and upon Nicaragua, Honduras, and contiguous regions of Central America, are recognized as having a great and permanent value. John Lloyd Stephens (1805–52) has also in his *Travels in Yucatan and Chiapas* revealed to the modern world a mass of interesting fact concerning the relics of the extinct races of Central America.

Olmsted.—Frederick Law Olmsted (b. 1822), first known by his *Walks and Talks of an American Farmer*, afterward wrote *A Journey in the Seaboard Slave States*, *A Journey through Texas*, and *A Journey in the Back Country*, which are historically among the most important books of travel that have been published in the nineteenth century, giving as they do, with all the candor and charity consistent with a love of freedom, an exact description of the social, moral, intellectual, and physical condition of the Southern U. S. a few years before the war of secession. Bayard Taylor (1825–78) visited no previously unknown, or even very remote, regions, but the extent of his travels, his careful observation, sound judgment, good nature, and agreeable style have gained his works in this department of literature a wide popularity.

Philosophy.—The philosophical writers of the English-speaking peoples during the nineteenth century have shown the influence of German or of Scotch thought, or have been chiefly critical of other writers or of earlier schools. Thomas Reid (1710–96), although belonging to the eighteenth century, has an affinity with the more modern Scotch metaphysical school, which he may be said to have founded by his *Inquiry into the Human Mind on the Principles of Common Sense*, and his *Essays on the Intellectual Powers*, *Essays on the Active Powers*, etc. He opposed the theory of Locke, and found in the innate and instinctive powers and consciousness of the mind the prime source of its knowledge and its stimulus to action. The objections against this theory were answered with great ability by Dugald Stewart (1753–1828), the next in order of the Scotch metaphysicians, whose *Elements of the Philosophy of the Human Mind* and *Dissertation on the Progress of Metaphysical and Ethical Philosophy*, the former by its acute analysis, the latter by its wide-reaching knowledge and attractive style, take a high place in philosophical writing of the second or non-originative class. Among works of this class Sir James Mackintosh's *View of the Progress of Ethical Philosophy* should be mentioned. Chief of this school, and perhaps ablest of modern metaphysicians, is Sir William Hamilton (1788–1856), whose writings upon the philosophy of perception, on eclecticism, and on logic are the fruit of a profundity and grasp of his deep and subtle subjects which, whatever may be thought of their absolute soundness, even their opponents regard as efforts in the very highest style of metaphysical dissertation. William Whewell (1794–1866) took an enviable position in this department of literature by his work on the inductive sciences. And here should be mentioned Richard Whately, Archbishop of Dublin (1787–1863), whose treatises on logic, on rhetoric, essays on some of the difficulties in the writings of St. Paul, and whose anti-Tractarian *Cautions for the Times*, and indeed all his writings, even those of a specially ecclesiastical character, are philosophical in tone and style, and almost so in purpose, and whose wide range of knowledge and vigorous intellect made a strong impression upon the general thought of his day.

Mill.—John Stuart Mill (1806–73), son of James Mill (1773–1836), author of *Analysis of the Human Mind* (1829), by his *Examination of Sir William Hamilton's Philosophy*, his *System of Logic*, and his *Dissertations and Discussions*, took a high place among modern philosophers of the Positive school, although he can not be regarded as a disciple or an apostle of Positivism according to Comte. His philosophic principles have been ably criticised by Dr. James McCosh (1811–94), who in a series of works, all opposed directly or indirectly to the positive and material tendencies of the day, took a prominent position on the conservative and religious side of philosophy. Of the same school was Dr. Francis Wayland (1796–1865), who gave to the American branch of the literature of morals and philosophy an admitted claim to the highest respect and consideration. Dr. Laurens Perseus Hickok (1798–1888), by his *Rational Psychology*, *Logic of Reason*, *Empirical Psychology*, and *Moral Science*, securely laid the foundation of a truly spiritual philosophy. George Henry Lewes (1817–78) should be mentioned as a contributor to philosophical literature by his *Biographical History of Philosophy*, *Aristotle*, and *History of Philosophy from Thales to Comte*—works of a philosophical interest and value not always merely historical. Nor should Henry James (1811–82), a subtle and aggressively independent thinker upon the philosophy of religion, and the master of a singularly impressive and suggestive style, be passed over; nor Dr. Mark Hopkins (1802–87), in virtue of his *Lectures on Moral Science* and *Love as Law and the Law of Love*; nor George Ripley (1802–80), the author of *Discourses on the Philosophy of Religion* and *Letters on the Latest Form of Infidelity*.

Theology.—As every clergyman is supposed to be more or less a man of education and of intellectual ability, and as every settled minister of a parish or congregation is required to prepare at least one sermon in every week, the amount of writing more or less theological in the English language is beyond computation, and increases weekly. Of this a quantity unaccountably large is printed. Only a very few even of the more distinguished clergymen who have made themselves known in literature in the nineteenth century can be noticed here.

Hall.—Robert Hall (1764–1831), a Baptist minister who for eloquence has been compared to Burke, and for fanciful richness of illustration to Jeremy Taylor, is distinguished not only by his sermons, but by his *Christianity Consistent with the Love of Freedom*, his *Apology for the Freedom of the Press*, and his *Modern Infidelity*. John Foster (1770–1843), also a Baptist minister, was not remarkable for pulpit eloquence, but his essays, particularly those on *Decision of Character* and the *Evils of Popular Ignorance*, are among the most thoughtful and weighty productions of their class in English literature. Thomas Chalmers (1780–1847) probably has been unapproached in eloquence and the vigor of his personality by any clergyman of the century. He was the most fervid and earnest of pulpit orators. His *Institutes of Theology*, *Commercial Discourses*, *Evidences of Christianity*, and *Astronomical Discourses* are his principal works. Isaac Taylor (1787–1865), a religious essayist of distinguished learning and ability, has discussed in *Ancient Christianity* the doctrine and the discipline of the early Christians, directing himself to the teachings of *Tracts for the Times*, a very remarkable and influential series of religious publications with a strong leaning toward Romanism, of which the principal writers were Edward Bouverie Pusey (1800–82), John Henry Newman (1801–90), John Keble (1792–1866), and Richard Hurrell Froude (1803–36), all clergymen of the Church of England and of the extreme High Church school, and all writers of independent theological works which have had a strong effect upon the tone of religious thought among the members of that Church.

Robertson.—Frederick W. Robertson (1816–53), a preacher whose sermons produced more effect upon the lives of men than those of any other modern minister of which there is record, stood at the ecclesiastical antipodes of the Tractarian men. His style was fervent, strong, and direct, his thought independent; he labored for the bettering of the working classes, and he was suspected of rationalism in religion and socialism in politics.

Bishop Colenso.—Doubts which must have occurred to many thoughtful readers as to the literal truth of many passages in the historical parts of the Old Testament, particularly in the earlier books, found strange and unreserved expression in a series of volumes by an eminent mathematician and clergyman of the Church of England, John William Colenso (1814–83), Bishop of Natal, the first of which was *The Pentateuch and the Book of Joshua Critically Examined*. Bishop Colenso had previously written several mathematical works, and he brought to his task habits of close reasoning and a calculating spirit, which led him to test these books by a standard to which Oriental writers, profane or sacred, never thought of conforming. Coming from such a quarter, his books, which he did not regard as at all impairing the divine origin of the Christian religion, produced a profound impression and very serious disturbance in the English Church, by the Convocation of which they were condemned.

Theodore Parker.—Theodore Parker (1810–60), at first a Unitarian minister, was a doubter of a very different character to Colenso. His faith was in God and in man, but not at all in revealed religion. A man of wide and varied learning, of independent spirit, of a tender and loving nature, the champion of the oppressed, the benefactor of the poor, his preaching the earnest utterance of his own strong personal convictions, he did much to unsettle the belief and to confirm the disbelief of a very large number of the most intelligent and purest minds in New England. Among his published works are *Sermons on Theism, Atheism, and Popular Theology*, and *Lessons from the World of Matter and the World of Mind*. Octavius Brooks Frothingham (1822–95), the ablest of his disciples, published little except from the pulpit; but his ability, his earnestness, and the polish of his style, in which he is superior to his master, make him a leader of rationalistic religion in the U. S. Henry Ward Beecher (1813–87), the ablest member of an intellectually gifted family, and a Congregational minister of the broadest and most liberal theological views, was regarded as the greatest pulpit orator in America—an eminence which the style of his published sermons hardly warrants. Andrew Martin Fairbairn (b. 1838), eminent among the Congregational ministers of Great Britain, has published a number of scholarly works dealing with religious questions.

Political and social science, properly speaking, is the product of the nineteenth century. Among the English works in this field the most important are those of Jeremy Bentham (1748–1832), to whom, next to Adam Smith, belongs the honor of originating the science of political economy. The mere titles of the various works produced by him in his laborious and self-sacrificing life would fill half this page. The spirit of all of them is concentrated in his famous saying, "The greatest good of the greatest number"—*good* here meaning material comfort and the happiness consequent thereupon. David Ricardo (1772–1823) published works of authority on the principles of political economy, giving his attention chiefly to the subjects of labor and currency.

Malthus.—Thomas Robert Malthus (1766–1834), also a political economist, in his *Essay on the Principles of Population as it Affects the Future Welfare of Society*, showed that population always rises to the level of possible subsistence. This work, says Brougham, "divides (with Ricardo) claims to a second place after the *Wealth of Nations*." The greatest of Bentham's disciples, John Stuart Mill, by his *Essays on Unsettled Questions in Political Economy*, his *Principles of Political Economy*, his essay on *Liberty*, his *Considerations of Representative Government*, and his *Subjection of Women*, has wrought into a systematic working form the principles of the Benthamite school, of which he was, and will probably long be, regarded as the chief apostle. His works are masterpieces of far-reaching thought and subtle reasoning. Of less note, but of high and well-deserved reputation, are the works of Henry Fawcett (1833–84). Francis Lieber (1800–72), born and educated in Germany, but for the greater part of his mature life a citizen of the U. S., was the author of several profound works in this department of literature, of which the most celebrated are his *Manual of Political Ethics*, *Legal and Political Hermeneutics*, *Essays on Property and Labor*, and *Civil Liberty and Self-Government*.

Carey.—Among champions of the "protective" system as opposed to free trade and unrestrained commercial intercourse, particularly in articles which are or may be of domestic manufacture, was Henry C. Carey (1793–1879), whose *Principles of Political Economy* and various other works embody in stringent phraseology all that can be said on this side of the question. Most of Mr. Carey's works have been translated into nearly all the languages of Europe. Herbert Spencer is the most eminent of recent writers in this department. His works cover the ground of psychology, biology, what he calls "sociology"—i. e. the philosophy of society—and morality, which it would be difficult to separate from the latter. In a word, he has attempted to work out a complete system of practical philosophy. His views on education are original and far-reaching. Indeed, he is one of the clearest and coolest thinkers of the age.

Of British writers upon education, one of the most important subdivisions of this department of literature, and one which has received attention commensurate with its importance, the Rev. Henry Parr Hamilton (1794–1880), the variously learned Francis William Newman (1805–97), and the distinguished physiologist Huxley (noticed again below), must be mentioned. In the U. S. two distinguished writers on education are Henry Barnard (b. 1811) and Frederick Augustus Porter Barnard (1809–89). The latter's *Letters on College Government* is regarded as "the ablest treatise on the higher education yet published in the U. S." He was also the historian of the U. S. Coast Survey and the author of an *Analytical Grammar*. Besides these, Horace Mann (1796–1859), Francis Wayland (1796–1865), Alexander Dallas Bache (1806–67), and William Torrey Harris (b. 1835) have written upon this subject with marked and widely recognized ability.

Jurisprudence is hardly a part of literature in the common acceptation of that term, but the *Commentaries* of Sir William Blackstone (1723–80) upon the laws of England added a charm to their dry and technical subject, and perhaps even deserved the conventional term "elegant" which was applied to them. They have certainly much of the interest of history. Appearing soon after the middle of the eighteenth century, they occupied this field with such a weight of authority that there seemed nothing to be done but to accept them and to comment upon them. In this department mention must be made of *The Constitution of England* of John Louis Delolme (about 1740–1806); *The Federalist*, a collection of papers by Alexander Hamilton, James Madison, and John Jay, which had a very important influence in bringing about the adoption of the Federal Constitution of the U. S.; the *Plan of the Penal Code of Louisiana* of Edward Livingstone (1764–1836), and his *System of Penal Law* for that State; John Marshall (1755–1835), whose judicial decisions, according to an eminent British critic, "would have done honor to Westminster Hall in the proud season of British law"; the *Commentaries on American Law* of James Kent (1763–1847), which, for their style as well as for their matter, are in Europe as well as in the U.S. successful rivals of Blackstone's great work; the *Commentary on the Constitution of the United States* of Joseph Story (1779–1845); the *Elements of International Law* of Henry Wheaton (1785–1848), which has become authoritative; the *Lives of the Lord Chancellors* and *Lives of the Chief Justices of England* of Lord John Campbell (1779–1861); the *Introduction to the Study of International Law*, which gave Theodore Dwight Woolsey (1801–89), distinguished as a classical scholar, an authoritative position universally recognized upon its subject; the *Comments on the Jurisprudence of . . . the Courts of the United States* and *History of the Constitution of the United States* of George Ticknor Curtis (1812–94); *The English Constitution* of Walter Bagehot (1826–77); *Ancient Law* and *Village Communities* of Sir Henry James Sumner Maine; and perhaps Sir Arthur Helps's wise treatise on *Government* should be added. This list is incomplete, but it is believed to include the principal works of this class which have been produced in the nineteenth century, and which can be regarded as within the pale of literature.

Lord Brougham.—Here, between the record of the literature of political and social science, of jurisprudence, and of natural science, may stand Henry, Lord Brougham (1779–1868), who wrote upon all these subjects, and who never wrote or spoke without impressing readers or hearers with the weight of his thought and the intelligent earnestness of his manner. The extent of his acquirements caused him to be called "a man of vast and various misinformation," and on his being made Lord Chancellor subjected him to the remark by Sugden, that "if the new Lord Chancellor only knew a little law, he would know a little of everything." But these were the jeers of specialists envious that the man who was great in their department of intellectual effort could also attain distinction in others—a not uncommon manifestation of human weakness. By his varied and voluminous writings Lord Brougham produced a marked and an enduring effect upon his time; and his efforts were always for the diffusion of knowledge, and toward liberty of thought and of action, subject to good morals and well-established law.

Natural science, like jurisprudence, is hardly literature (whence the distinction so constantly drawn, "science *and* literature"), but it would be difficult to deny a very high literary quality to the works of many of the naturalists who have given to the nineteenth century that scientific eminence which is its peculiar glory. Of these the most eminent are Joseph Priestley (1733–1804), a leader in the modern school of natural science, who, living into the nineteenth century, labored chiefly in the eighteenth, writing upon government, history, and grammar, although the works by which he impressed the world were those in which he brought natural science to the support of materialism; Thomas Young (1773–1829), the reviver and demonstrator of the truth of the undulatory theory of light, who first deciphered hieroglyphics by the aid of the inscriptions on the Rosetta Stone, whose *Lectures on Natural Philosophy* are even at this day a treasure-house of scientific truth to the investigator, and whom Tyndall has pronounced to be the greatest intellectual power in England since Newton's day; Sir Humphry Davy (1778–1829), who discovered the qualities of nitrous oxide and of the metals of the alkalies, and invented the miner's safety-lamp, and whose scientific sagacity was adorned with a charming style which makes his *Salmonia* and *Consolations in Travel* classic books; Sir David Brewster (1781–1868), whose works cover an extended field of science, including biographical appreciations of great natural philosophers, but whose most interesting philosophical writings are those which record his investigations and develop his theories upon light; Sir John Frederic William Herschel (1792–1871), the eminent son of an eminent father, whose principal works are his *Treatise on Physical Astronomy* and *Results of Astronomical Observations at the Cape of Good Hope*, which map out the whole starry heavens; Sir Charles Lyell (1797–1875), first of English geologists, by whom attention was drawn to the ancient changes in the earth and its inhabitants as illustrated by its geological monuments, and whose books of travel in the U. S. are among the few of much value; William Buckland (1784–1856), who brought a profound acquaintance with geology and mineralogy to the support of religion; Sir Charles Bell (1774–1842), who made surgery one of the fine arts, and by his work on *The Hand, its Mechanism and Vital Endowments*, revealed marvels and mysteries of design where the unlearned reader would least expect them; Sir Roderick Impey Murchison (1792–1871), who attained the highest geological distinction by the conception and establishment of his Silurian system, by which he brought under scientific light a formation of rock beneath the old red sandstone; this, named Silurian from the place in England where he studied it, he followed into Norway and Sweden, and finally into Russia, his book recording his geological survey of which vast country is one of the important works of modern science; Michael Faraday (1791–1867), the most eminent of English experimental chemists; Mary Somerville (1780–1872), one of the very few real women of science the world has seen (the womanhood being as true as the science), whose works on the *Mechanism of the Heavens* and the *Connection of the Physical Sciences* have won the highest approval both for their profundity and their clear and simple style; and Hugh Miller (1802–56), a quarryman, who from observations made during his daily labor became one of the leading geologists of his day, adding to exact knowledge a beauty of style and a richness of illustration rarely found in scientific books. He took his place among those men of science who seek to support revealed religion and to reconcile the Mosaic cosmogony with the records of nature. His principal works are *The Old Red Sandstone* and *The Testimony of the Rocks*. In 1845 appeared an anonymous volume, *Vestiges of the Natural History of Creation*, a work which, at first spoken of slightingly by scientific men as the fruit of presuming sciolism, proved to be the first utterance of the new school of development. Its style, no less than its startling views, won it worldwide attention. It is now known that its author was Robert Chambers, of Edinburgh.

Charles Darwin.—Charles R. Darwin (1809–82, grandson of Erasmus Darwin, 1731–1802, author of the *Botanic Garden* and *Zoönomia*) was the leader of the school of development. He had published several works on natural science, the high value of which was recognized when his *Origin of Species by means of Natural Selection* renewed the surprise which followed the publication of the *Vestiges of Creation*; and yet, although it prepared the way for, and led naturally to, his last work, *The Descent of Man and Selection in Relation to Sex*, that book was received with a mingling of admiration and horror for the author who seemed to prove that "man is descended from a hairy quadruped furnished with a tail and pointed ears, and probably arboreal in its habits." Louis John Rodolph Agassiz (1807–73) is eminent among the natural philosophers of the century by his works upon fishes, living and fossil, but chiefly by his glacial theory of certain geological formations, which he developed in his *Studies of Glaciers*. In comparative zoölogy and comparative physiology his investigations have been of great importance and interest. He did not accept the theory of development. John Tyndall (1820–93) is also distinguished for his glacial researches, his analysis of the solar ray, his discoveries as to light and heat, and is one of the school of philosophers to which Darwin and Huxley and the author of the *Vestiges of Creation* belong. His writings and his lectures have an intrinsic charm besides their scientific value.

Huxley.—Thomas Henry Huxley (1825–95) is the noted author of *Man's Place in Nature, Lectures on Comparative Anatomy, Lessons in Elementary Physiology*, and other works, all of a "positive" or quasi "positive" character and materialistic tendency. Of American scientific writers, some of the most distinguished are Alexander Dallas Bache (1806–67), whose place in education has already been mentioned, but who was eminent in magnetic and meteorological science, whose many contributions to the proceedings of the American Association for the Advancement of Science are among the most valuable in the repertory of that society. Samuel George Morton (1799–1851), naturalist and ethnologist, author of *Crania Americana* and *Crania Egyptiaca*; George Robins Gliddon (1809–57) and Josiah Clark Nott (1804–73), whose *Types of Mankind* and *Indigenous Races of the Earth*, although criticised by men of science and theologians, are filled with effective groupings of significant facts illustrated by ingenious suggestions; Asa Gray (1810–88), one of the most eminent botanists of the day, as he has shown in his various works upon the flora of North America; Benjamin Silliman (1779–1864), the geologist and mineralogist; John Torrey (1796–1873), botanist, chemist, and metallurgist; and Arnold Henry Guyot (1807–84), who brought to his adopted country a profound acquaintance with physical geography, previously set forth to the scientific world in works of recognized value, and now diffused among younger students by his books of elementary instruction.

Audubon.—Among naturalists, John James Audubon (1780–1851) must not be forgotten, because of his close observation of the habits of birds and his life-size paintings of the birds of America. Henry Maudsley's writings upon what may be called mental physiology are of the profoundest scientific and psychological interest, and have a singular literary charm. His *Body and Mind* and *Psychological Essays*—in the latter of which is a subtle appreciation of the character of Hamlet—and his *Physiology and Pathology of Mind*, are his principal works. The latter of these works, rich with the lore of various ages and climes, and seeking to penetrate to the very seat and reveal the very mode of thought, was published in 1873. To such a point has the English language and literature advanced.

The following standard works may be consulted for further information: Gustav Körting, *Grundriss der Geschichte der Englischen Litteratur* (Münster, 1887); Henry Morley, *English Writers* (9 vols., London, 1887–92); Hippolyte Adolphe Taine, *History of English Literature*, translated by H. Van Laun (2 vols., New York, 1871); George L. Craik, *Compendious History of English Literature* (2 vols., New York, 1863); Thomas Warton, *History of English Poetry* (3d ed. by W. Carew Hazlitt, London, 1871); John Earle, *Anglo-Saxon Literature* (London, 1884); Thomas Wright, *Biographia Britannica Literaria* (vol. i., Anglo-Saxon Period; vol. ii., Anglo-Norman Period, London, 1842–49); Bernhard ten Brink, *Early English Literature*, translated by H. M. Kennedy (New York, 1873); Bleibtren, *Geschichte der Englischen Litteratur im Zeitalter der Renaissance und der Klassizität* and *Geschichte der Englischen Litteratur im 19 Jahrhundert* (Leipzig, 1887); George Saintsbury, *History of Elizabethan Literature* (London, 1887); Edmund Gosse, *History of Eighteenth Century Literature* (London, 1889); Adolphus William Ward, *History of English Dramatic Literature* (2 vols., London, 1875); Edmund C. Stedman, *Victorian Poets* (Boston, 1886); M. C. Tyler, *History of American Literature, 1607–1765* (2 vols., New York, 1878); C. F. Richardson, *American Literature* (2 vols., New York, 1887). RICHARD GRANT WHITE.
Revised by HENRY A. BEERS.

English Pale, called also the **Irish Pale**, or simply **The Pale**: in history, that part of Ireland which was under English law previous to the final and complete subjugation of Ireland. In a general way the English Pale may be defined as corresponding with the present province of Leinster, besides Cork, Kerry, Waterford, Tipperary, and Limerick. But, in point of fact, the actual Pale, though of extremely variable limits, scarcely ever reached the dimensions indicated above. The counties of Dublin, Meath, Carlow, Kilkenny, and Louth were almost always within the Pale; Wexford and Waterford, though hardly within the Pale, were firmly English; while Wicklow and Kildare, though nominally within the Pale, were Celtic, and to a considerable extent independent. In strict language *the Pale* denotes the "boundary-line," but it is commonly used for the region itself.

English River: an estuary of Southeastern Africa, communicating with Delagoa Bay about lat. 25° 58′ S. and lon. 32° 36′ E. It receives several broad but unimportant streams (Tembia, Mattol, and Dundas rivers), and is surrounded with mangrove flats.

English River: a river of Iowa; formed by the union of two forks, the North and the South; flows eastward, entering the Iowa river 15 miles S. of Iowa City.—Another English river enters the Red Cedar river in Black Hawk co., Ia.

English Seventh-day Baptists: See SEVENTH-DAY BAPTISTS.

Engrafting: See GRAFTING.

Engrailed [partic. of vb. *engrail* < Mid. Eng. *engrele* < O. Fr. *engresler* or Mod. Fr. *engrêler*, probably meaning hailed upon, indented with hail; *en* < Lat. *in* + *grêle*, *gresle*, hail, loan-word from Teutonic; cf. O. H. G. *grioz*, coarse sand]: in heraldry, edged with small semicircles or crescents, the points of which are turned outward. The semicircular marks or dots around the edge of a coin are called engrailments.

Engra'tia, also called **Encratis**: a saint who lived at Saragossa, Spain, in 304. She was persecuted as a Christian under the Emperors Diocletian and Maximianus Hercules; and, according to the poet Prudentius, she underwent the most fearful tortures, but, notwithstanding the dreadful mutilations which she received, she survived to a great age, and died in the odor of sanctity. Her relics are preserved at Saragossa. Her festival, as observed by the Roman Catholic Church, occurs on Apr. 16.

Engraving [prefix *en* + vb. *grave* < O. Eng. *grafan*: Germ. *graben*, dig, carve. Not connected with Gr. γράφειν, write, which corresponds probably to Eng. *carve*]: the process of cutting grooves or small hollows in a hard surface, more especially letters, characters, or works of art; by extension, carving a surface with characters in relief, as in WOOD-ENGRAVING (*q. v.*). Engraving differs from chasing in the fact that the substance is cut away, while in chasing it is merely depressed or beaten down. Engraving on a large scale is seen in all incised lettering and cutting of emblems, characters, and the like, as on marble or stone; this was an art very much studied and followed among the ancient Greeks and Romans. (See INSCRIPTIONS.) Among the enormous number of inscriptions cut in marble which are left us from classical antiquity there are very few in which the letters are in relief; they are *engraved*, even when a bas-relief of figures is sculptured on the same piece of stone. Other engraving in large compositions, though the incised lines are narrow and not deep, is that to be seen in the numerous monumental brasses of the Middle Ages. A peculiar kind of relief sculpture, much used in Egyptian art for carving inscriptions and figure-subjects on very hard stones, and used also in the arts of China and Japan, is known as *cavo-rilievo* and by other names (see RELIEF), and may be considered a kind of engraving. Engraving on brass or bronze plates is used in modern times chiefly in memorials to the dead, and in simple lettering instead of the elaborate figure-subjects of the Middle Ages. Incised letters on marble, granite, or stone are common in tombstones and sepulchral monuments, but rare in other places in modern practice. On the other hand, the moderns carry further than the ancients seem to have done the art of engraving on metal in small ornamental designs for the purpose of decorating vessels for table use and for general display, such as gift-vases, race-cups, etc. Thus there are many showy pieces of silverware of the eighteenth and nineteenth centuries in which engraved festoons, wreaths, scrolls, and the like form the chief part of the ornamentation. Sometimes parts of the same vessel are chased in more or less high relief, and other parts are smooth and ornamented with engraving, the contrast between the two kinds of ornament being dwelt upon. The Orientals have sometimes used such engraving on metal with extraordinary skill and good taste, far surpassing the work of Europe in the effect produced by simple means; thus in Japanese metal-work of the eighteenth and nineteenth centuries small objects of silver and bronze, and even pieces as large as sword-sheaths, are adorned with engraved bouquets and sprays of flowers, suggestions of landscape, and the like, in which the varying width and depth of the incision are made to produce the most vigorous decorative effect. Other engraving on a small scale and on metal is seen in the *nielli* of the later Roman times, the Middle Ages, and of the Renaissance; it is common also in Russian art of the nineteenth century. (See NIELLO.) In these, as in the large monumental brasses of the Middle Ages, the incised line is filled up with a black compound, whereas in other ornamental engraving the play of light and shade in the V-shaped groove is enjoyed and counted on. In enamel-work also much use is made of engraving, *champlevé* enamels being prepared by engraving out the figure upon the background. (See ENAMEL.) Die-sinking is engraving upon fine steel which has previously been softened. (See DIE.) Dies so prepared are used in coinage of money, in striking medals, etc.; but dies are also cut for stamping seals in wax or upon paper, for raising ornamental letters on fancy stationery, etc. That important branch of engraving which consists in preparing plates from which impressions may be taken upon paper is treated of below.

In all these cases the tools used by the engraver are somewhat similar in character. They are straight, sharp, edged or pointed tools, impelled by hard pressure or by light taps of a mallet, and are used as chisels, stone being cut away by them in small fragments, and metal in curled-up shavings.

But there are some kinds of engraving which are done by rapidly revolving drills or wheels, in part or altogether. Of these the most important is the engraving of seals on very hard stones (see GEM); but there is a great deal of fine engraving done upon vases and cups of rock crystal, jade, agate, and the like. This work is mostly done with revolving wheels coated with emery powder, though the diamond point is used for very delicate and artistic work. Thick glass is also engraved, very much as is done with rock crystal; but as some acids attack glass readily, etching is resorted to in order to facilitate the work, and sometimes glass is ornamented wholly by etched patterns. See *Etching* (below).

The most important kind of engraving in modern times is that which is done for the purpose of making prints from the engraved surface. It was found in the fifteenth century that an engraved plate of metal would hold any coloring-matter, ink, or the like, so perfectly that an impression taken on paper would show every line, scratch, and dot of the engraving in uniform proportionate size and force of color, and that it would do this every time, so that a hundred impressions could be taken, all of which would be complete and practically the same. The tradition is that it was a *niello* used as a pax in the hands of a Florentine silversmith, Maso (i. e. Tomaso, or Thomas) Finiguerra, which first yielded an accidentally made print so good as to attract the artist's attention. Within a quarter of a century the new art process had become known throughout Western Europe. The different methods of engraving the plate of metal were introduced one after another, though some of them, as mezzotint, were not in use till two centuries later.

All the different ways of engraving a plate by hand, as distinguished from modern chemical processes (see PHOTO-ENGRAVING), may be classed under two heads: first, engraving by the hand and the steel tool alone; second, engraving by means of acid, which is guided by the work of the hand and the tool to attack certain portions of the plate and to spare others. In the first class come *line-engraving*, *stipple* (sometimes, and especially when used with line-engraving), *mezzotint*, *dry point*, and perhaps the dotted manner or *manière criblée*. In the second class come etching and aquatint. For work in either class almost any common metal will serve. Soft iron, steel, zinc, copper, have all been used; glass also has been used for etching, and stone for etching and dry-point work alike, which work upon stone has of course nothing to do with LITHOGRAPHY (*q. v.*), but is pure engraving in the strict sense. Copper has been from the outset much the most commonly used of all metals, but steel was employed from about 1815 for work from which many copies were to be taken. This again is becoming less common since the introduction of the process of steeling copper, by which the surface of an engraved plate can be covered with an electro deposit of steel so thin as to scarcely mar the delicacy of the work, while it is indefinitely capable of renewal, and serves to protect the soft copper, so that thousands of copies may be printed without injury to the plate.

Line-engraving is called also *burin-engraving*, from the name of the tool most used in it. This is a bar of steel, usually four-sided, and having the end cut off at such an angle as to leave a lozenge-shaped point. The other end is set in a short wooden handle, with a smooth rounded back upon which the hand presses, pushing the burin slowly along the line which it is to follow, where it turns up a curled shaving of metal. The lines cut in this way may be extremely fine, as in well-known engravings by Albert Dürer, mentioned below, or broad and deep, as in much foreground work in large compositions. The metal which is left clinging to the edge of the engraved line, like the soil turned up by the plowshare, is called the *burr*, and this is usually removed by the *scraper*. Burins of different sizes and with the points ground at different angles are used; each kind of work has its fitting tool, and each artist his own preferences. It is usual to begin the work of a line-engraving by drawing the whole subject on the plate in fine lines, by means of *etching*, or in parts, by the etching-needle alone without the use of acid—the *dry-point*, in short. Let us suppose that the engraving is to be a portrait of Mr. Gladstone. The engraver, whom we assume to be also a portrait-artist of ability, has made several studies of his subject and has secured photographs also of the head and body in the attitude fixed upon; he prepares now his definitive drawing of the subject complete, as he means to engrave it, background and details of dress and all, and this drawing in a sort of highly finished outline, or without masses of shade, etc., he wishes to transfer to his copper plate. Of course if he lays the drawing face downward on the plate and the lines can be so transferred, the image on the plate will be reversed, as in a looking-glass; but this is what is wanted, because then the impression taken from the plate upon paper will come right again. The plate is covered with a *ground*, as described below under *Etching*, and the outline drawing is rubbed off or transferred to this, where it shows plainly enough. Every line and dot of this drawing is then carried through to the copper by the etching-needle and acid or by the needle without acid, and when the ground has been melted off the highly polished plate is seen to have a lightly traced outline drawing, in which the whole subject is reversed. The plate is then inked and two or three impressions are taken upon dampened paper. As soon as the ink has begun to enter all the lines freely every lightest and faintest scratch comes off in black on the paper, and the artist can tell better by the study of this print than from the gleaming copper with its bright or blackened lines and its reversing whether any further touches are needed to bring his whole composition into shape. Any slight change can be made by the etching-needle if it is a question of adding something, or by the burnisher if something is to be taken out. Finally, work begins with the burin, and a patient toil of several months brings to perfection the plate from which are printed the black and white pictures erroneously called "engravings"; more properly, *prints*. Two years will sometimes be given to a large subject of many figures.

By far the greater number of modern line engravings have been copies of paintings by other artists than the engraver. In this common case the following device is often used to aid the engraver in making his first drawing: In front of the picture is placed a network of fine threads, crossing each other at right angles and having the squares left between them of exactly uniform size. Corresponding lines are applied to the sheet of paper on which the drawing is to be made. As each small square on the paper represents a square of the picture, the operation of copying the picture in outline goes on with comparative ease and rapidity.

If prints of the work of different engravers be compared, it will be seen that many different ways exist of using the engraved line. Sometimes it is very simple, indeed, as simple as a common pen-and-ink drawing; but sometimes an elaborate system is adopted, as where pains have been taken to make all the lines cross one another so as to leave lozenge-shaped spaces, in each one of which there is a dot or a cross. Nearly always such uniform systems are an abuse, as the engraver is then seeking this trivial effect instead of the best results of art in general. But the history of line engraving shows many such affectations and mannerisms, and it has always been unfortunate in being much employed for showy copies of famous pictures, generally inaccurate, and always misleading to the student of painting, while they are not the best employment work for the engraver. Of the great amount of excellent work and well-used skill which has been given to line engraving during 400 years, something will be said below.

Stipple-engraving, or simply *stipple*, is generally considered a branch of line-engraving. It is done by making points or dots instead of continuous lines. In almost any line-engraving, or in a print from it, it will be seen that the burin has ceased to draw its lines strongly and continuously in the spaces where the light is strongest; its lines have become broken rows of short dashes, or even rows of dots. *Stipple* consists merely in carrying somewhat further this way of getting light and shade. It is often, perhaps more usually, combined with ordinary line-engraving; thus in many modern portraits the head will be wholly modeled in stipple—that is, all its forms shown by means of light and shade, which is produced by dots, larger, smaller, more crowded, or more widely spaced—while the clothes, etc., are given in full line-engraving. Stipple may be done also by means of acid as stated below.

Dry-point work is done with a sharp-pointed tool like the etching-needle, but without acid (see *Etching*, lower down). The difference between this and burin-engraving is then very great: it is all the difference between *scratching* and *plowing*. The burin is held strongly in the hand, and the palm pushes the stiff steel bar before it, end on, with slow and continued pressure; but the etching-needle is held like a pencil or a pen, and its strokes are downward or sideways, like those of a pencil or pen when used in making a drawing. A *burr* is raised by the strokes of the needle, but this is small and fine, and when partly left on the plate it takes the ink readily, and yields a rich velvety bloom which is much admired in those prints which are called especially "dry-points." But apart from the plates which yield such prints as these, dry-point work is used continually in touching up and finishing all kinds of line engravings and etchings, and in these cases the burr is removed exactly as in line engraving.

Mezzotint, called by the French *la manière noire* (the black style), is produced by first scratching and notching the plate all over so that an ink-print from it would be one solid black, and then scraping and polishing parts of the plate so that it will no longer hold the ink, or at least not so much of it. This process is in one sense the reverse of burin-engraving and dry point, because in those the artist produces the dark upon the light, while in mezzotint the light is produced upon the dark. The plate may be roughened in any way that will produce a uniform surface, but the usual way is to employ what is called a "rocker" or "cradle," or in French *berceau*, a large blade like a chopping-knife, the edge of which is a regular curve, and is sharpened like a very fine saw, except that the teeth have sharp points. Philip Gilbert Hamerton, an excellent authority, has counted the teeth in his *berceau*. He reports 110 of them in a width of $2\frac{1}{2}$ inches, and he calculates that there will be 2,640,000 little points or dots produced by it in a plate 5 inches by 6, because the *berceau* must be rocked across the plate in different directions about eighty times to produce a well-prepared mezzotint plate. Upon this elaborately produced roughness the artist works with scrapers and burnishers. Where the copper is brought to perfect smoothness again the ink will be removed when the plate is wiped, and the paper will come white in the print; and between this and the complete solid blackness of the mezzotinting all gradations are easily obtainable. The fault of mezzotinting, in copper at least, is that it allows of so few good impressions. Twenty or thirty prints are all that can be taken perfectly; after that the plate must be retouched and reworked, or the prints are more and more feeble.

As for the *criblé*, or dotted manner, it is not known how the curious and rare early prints known by this name were produced; it is probable that they are from *relief-engravings*, not unlike wood-engravings in character.

Etching is much the most important process of engraving by means of acid. It is done by exposing the plate to the acid at all the lines and points which are to be engraved, and protecting it everywhere else; and by exposing some such lines or points for a longer time than others, if they are to be engraved deeper. The lines and points so engraved by the acid are said to be *bitten*, and the corroding itself is called the *biting-in*. The substance which protects the plate from the acid is called the *ground*, or the *etching-ground*; it is generally composed of a mixture of wax, some vegetable resin, such as mastic or white pitch, and asphaltum. This is spread all over the plate while hot, and then allowed to cool. This ground is blackened by smoking it over the flame of wax candles, and the black surface is made to look very smooth and uniform. Upon this smooth and slightly glossy black surface the artist draws with his etching-needle, which easily cuts its way through the ground so as just to lay bare the copper below, or even to scratch it slightly. Some etchers prefer a sharp point which scratches the plate decidedly, others a rounded point which glides over it. It is then ready for the acid bath. This is often nitric acid and water, though many different *mordants* are in use. It is quite possible to bite the whole plate at one time and to leave it so, but it is usual to expose some of the lines to the acid for a longer time than others, and even to use mordants of different powers. It is customary also to clean the plate and print from it on paper one or two proofs to enable the artist to judge of his work. The plate can then be regrounded by a simple apparatus which leaves unfilled the lines already cut in the copper, and these lines themselves can be protected from the acid at pleasure by *stopping-out* with a varnish of some sort which can be put on with a brush. An etched plate is, then, an engraving of which the sunken or engraved lines have been eaten out by acid, the metal having wholly disappeared from those sunken places, leaving the plate around them clean and smooth. Stipple-engraving, as in Bartolozzi's work, is partly done by acid, which bites deeper the points made by the graver; it is then a variety of etching.

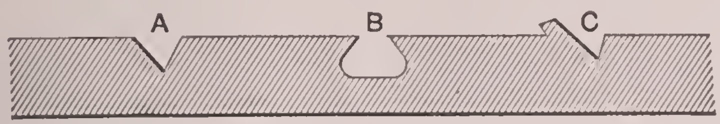
Aquatint is the only other important kind of engraving with acid, and it is of much less importance than etching because it has never been much in favor among artists. In itself it is a beautiful art, and the results are often delicate and forcible; but only a few workmen have found it to their taste, and it is used chiefly as a help in engravings of other kinds. The plate is covered with a ground which is much less solid and uniform than the etching-ground; usually some kind of resin is employed, either in powder or dissolved in alcohol, which solution, as it dries, leaves the resin in a surface much broken up by the shrinking of its parts. If the plate with this ground upon it be covered with acid, a somewhat uniform granulation is produced. By using different grounds in succession, applying the acid in each case to certain parts and not to others, different degrees of granulation are obtained; smaller parts of the plate are treated with varnish and a brush, and, after the acid has done all it can, the scraper and burnisher may be employed as in mezzotint.

Soft-ground etching is still another manner of engraving by means of a mordant. This also is not very frequently used by artists. It produces a print which strongly resembles a drawing in lead-pencil. The etching-ground used is made very soft; a sheet of paper is stretched tight upon it, and upon this paper the drawing is made. When this paper is removed, the ground comes away with it along all the lines of the drawing, and then the mordant is used as in ordinary etching.

These different processes are often combined one with another; thus there is very often pure etching to be seen in what is mainly a line-engraving; stipple and line engraving pass insensibly one into the other; dry point is used to touch and finish an etching, and a fine burin is used also by many etchers. But in addition to this there are some more deliberate and more notable combinations, as when a plate is etched with a design in what may be called outline, that is, the main lines only of the composition being given, and is then covered with mezzotinting or with aquatinting, in which second engraving the design is completed in light and shade and by the addition of many details. When a print is taken from such a finished plate, the soft gradations and tints given by the mezzotint or aquatint are re-enforced and made more vigorous and telling by the strong lines of the etching. This has been rarely done except by Earlom in the *Liber Veritatis* and in the important instance of Turner's *Liber Studiorum*.

Prints from plates prepared in any of these different ways require a certain care and skill if they are to be as good as possible. Although the ink is held readily by every large or small groove, scratch, or dot in the plate, and then comes out of it as readily when dampened paper is pressed against it, yet to keep the plate in perfect order, to apply so uniform a pressure that all the ink shall leave the plate at each separate impression, and also without wearing out the plate unduly—all requires training and some artistic skill, even in the simplest kind of printing. But printing is sometimes done in a much more elaborate way, the plate being left with its polished surface partly smeared with the ink instead of being wiped absolutely clean. When this is done, every separate print becomes a separate work of art, in a sense, for the printer has deliberately, and with calculated touches of a cloth, spread some of the ink which had been in the engraved lines over the smooth metal between the lines. No two impressions in such a case are really the same. No two prints of an edition printed in that way are facsimiles of one another. But as this process is very slow, and as there are but few printers living at any one time who can do such work well, nearly all printing is done simply, the plate inked with a roller (formerly with dabbers), and then cleaned off bright between the engraved lines. Etchings are printed in the artificial way more often than other kinds of engravings; burin-engravings very rarely. Different kinds of paper are used for prints. It is thought that certain Japanese papers take the ink with more uniformity, and show a clearer and more beautiful impression than any other sorts. What is called India paper comes next. This is generally stuck down fast to a sheet of heavy plate-paper, the thin India paper being cut only a little larger than the plate, and a broad margin of the heavier paper being left on all sides. These "proofs on India paper" have been in use for many years for prints from line-engravings, mezzotints, and all the kinds most used in the art trade, but Japan paper is more generally used for etchings and dry points.

Engraved plates wear down in printing in such a way that the engraved lines become less distinct. The prints, therefore, are less and less fine and desirable, beginning with the first print which is taken after the ink has thoroughly entered the engraved lines. From a mezzotint not more than twenty or thirty copies can be taken before a visible deterioration begins; from a dry point not more; from



Section of a metal plate engraved by lines in burin-work, etching, and dry point.

an etching perhaps twenty-five, perhaps fifty, according to the style of the work; from an aquatint about the same number. The process of steeling is not perfectly applicable to such plates, and does not protect them wholly. In the cut, B represents the cross-section of a line bitten by acid in an etching, the acid having eaten its way under the surface more widely than where the metal is protected by the ground. The groove made by the dry-point is as at C, the *burr* being left on one side, like the soil turned up by a plowshare. It is clear that these engraved lines will undergo rapid changes from contact with damp paper under heavy pressure, while the line A, produced by the burin, will suffer less. Moreover, steeling the plate will protect the one almost perfectly, especially if it is renewed, while B and C can not receive so much benefit from this process. But in practice steeling is not used for the finer and more artistical works of the engraver, and accordingly a great system of *proofs* and *early* impressions has been built up, partly a necessary and obvious resort, partly mere advertising.

The ordinary, large, showy prints of popular subjects are generally taken from their plates, according to some such classification as this: First, there are engravers' proofs, which are supposed to be taken by the engraver for his own guidance and not to be for sale; one of these will command a high price, just as a proof taken before the completion of the plate may command a high price, its necessary scarcity and a supposed interest in seeing the plate's condition at a time before the final touches bringing it into demand. The proofs that come first of the regular published edition are often *remarque* proofs; that is to say, a slight sketch with the point will have been made in the margin of the plate—a head, a dog, even a little group—and this sketch, which shows in the proofs, marks the fifty copies or so which are taken before its effacement. Then come artist's proofs, and all this time there are no letters of title or description added below, on the margin, so that all the proofs of these different classes are proofs *before the letter*. Sometimes the lettering is put on gradually; the engraver's name and that of the painter or draughtsman, if a different person from the engraver, will be added before the title, and more subdivisions of proofs are made possible in this way. Then there are proofs *before letters*—that is, before the title or legend is added—and, next, the proofs *with open letter*—that is, with the title or legend in outline. All of these proofs will probably be on India paper. Finally, and printed directly on plate paper, are the *prints*, commonly so called; one of these will cost the buyer a moderate sum, which will be doubled for an open-letter proof, and probably multiplied by ten for a *remarque* proof. No doubt all of this is open to the suspicion of being mainly advertisement, in the case of steel or steeled-copper plates, but it dates from a time when the copper plate really did wear away in a serious fashion. But etchings and dry-points and fine mezzotints will not yield so many impressions, and there is less ceremony about them. An early impression may be even more decidedly superior to a later one than in burin-engraving, but as the prints are rather for artists and specially instructed buyers there is less need to insist upon these distinctions. It often happens that a plate is announced as to yield fifty or one hundred copies only, all of which are supposed to be of equal value, and then to be destroyed; and the plate, duly scored across and across again with deep plowings of the burin, is exhibited, or impressions of it are exhibited, to confirm the assurance that no inferior prints shall ever be taken from it. The real test of the excellence of a print is of course the eye. It is so that we judge of and decide between impressions of ancient engravings, and it is so that one would always do with modern ones, when the opportunity is afforded. Comparison of one impression with another is especially to be sought for; very often a print seems good and even brilliant, when a moment's comparison with a better one will make it seem feeble.

The history of engraving for printing is rather the history of *prints*, for it is the latter which the student sees and studies. Few engraved plates of old masters of the art exist, and those few are not readily accessible. Prints from plates engraved for niello are the earliest (see first paragraph), and belong to the years about 1450–70. Here no artistic intention is to be presumed; the engraver was only proving his work as he went along, and never thought of preserving the paper prints. But one very skillful artist who worked for printing, Martin Schongauer, of Augsburg (d. 1488), left behind him a number of prints, and perhaps also engraved plates from which prints were taken after his death, and these are of very great merit as works of careful finish and apparent ease of execution. There is some fine Italian work almost as old; as the fifty "cards," or *Tarocchi of Mantegna*, as they are called, though they are not playing-cards in any usual sense; the prints marked by a caduceus and now ascribed to Jacopo di Barbari, and those rightly given to Mantegna. Many still earlier dates are given, but it is safe to say that artistic engraving on metal, for printing, dates from 1460 in South Germany, and perhaps 1470 in North Italy. Albert Dürer left prints of great beauty and showing extraordinary skill with the burin, but attracting more attention relatively than they deserve because of their poetical feeling and certain mystical character of some of them. Barthel Beham gave, in his *Portrait of Charles V.*, perhaps the most truly artistic burin-engraving that has ever been made. Henry Aldegrever was another able engraver; and contemporary with him, in the first half of the sixteenth century and in Germany, there were a body of "little masters," so called partly from their very diminutive engravings and partly from their rank as artists, assumed to be inferior to that of the greatest men of the time. Lukas van Leyden, who died in 1533, represents the art in Northwestern Europe at this time, and is a skillful engraver, though his power of artistic design is far inferior to that of some of the great Germans.

Meantime in Italy there were few artists who gave themselves up to engraving with the entire devotion of the Germans. Of the men who died before 1550 Giulio Campagnola and his two brothers deserve special mention; but much the most famous is Marcantonio Raimondi. His special celebrity is not in the excellence of his engraving, considered technically, but in the beauty of the compositions which he engraved. Some of these are known to be Rafael's, and very many of them are either his or founded upon him; and as the original drawings, etc., are generally lost, the engravings are the more precious. In the mere engraving neither Marcantonio nor any of the early Italians could compare for a moment with Dürer or Beham. In the hands of the Germans the burin was made to move almost as freely as a pencil, while to the Italians it was a difficult tool to manage. The Italians drew careful outlines with it, and then shaded the figure within these outlines; Mantegna with parallel, diagonal lines, nearly straight, Marcantonio with finer lines, often crossing, and somewhat more easily curved. In Mantegna's case the modeling of the figure by shading is admirably suggested, but only suggested; in Marcantonio's work the modeling is more elaborate but often very poor, while the backgrounds and details are generally trivial, and the skies of no value whatever, either of observation or rendering. Much of this is caused by the fact that Mantegna engraved his own designs, Marcantonio the masterly but slight drawings of a great painter, which he followed as far as they led and which then left him helpless. Marcantonio seems, moreover, to have been resolute not to do to his plate anything which it was not perfectly easy to do with the burin; and, as the designs he engraves are elaborate, this restraint is very noticeable. But Dürer, Beham, and in a less degree other Germans, united outline and shade in one, producing an effect far more like that of painting than of the awkwardly incised niellos which the Italians had not quite left behind them. Had engraving never gone beyond Marcantonio designs would have to be made of great severity and reserve, especially for interpretation by this means; whereas Dürer's work is on the track which engraving has followed since, trying everything, and using etching, dry point, and burin in free interchange to attain a result of great complexity, depth, and variety of shade and richness of tone.

The half-century following the deaths of Marcantonio and

Barthel Beham was not a time of great achievement in engraving. The prospect of its becoming a great independent art, bringing home artistic thought to people of small means as freely as printing was bringing to them literary thought, was growing dim; it was one more disappointment of the bright hopes raised by the Renaissance. Theological controversy, often taking the shape of bloody persecution and often of set and recognized war, was what men were thinking of, and the great living art of the time was protected by the Venetian lagoons. Italians like Giorgio Ghisi (d. 1582) were doing elegant work, more elaborate than Marcantonio. Stronger men, like Agostino Carracci (d. 1602), carried on the elaboration of work without losing themselves in prettiness, and their especial success was in portraits of their contemporaries. Flemings, of whom Henry Goltzius (d. 1617) was the chief, were eclectic in their tastes, now Italian in manner, now copying Dürer's ways closely—at their best in original portraiture, as in Goltzius's famous *Henry IV. of France.* Portrait-engraving was indeed the one distinct and original success for the art, and at intervals ever since this has been evident, so that no one branch is, on the whole, so well worthy of study. Thomas de Leeuw, called also De Leu, as having been long resident in France, left behind him, when he died about 1620, some 500 different works, most of which are portraits; these also mainly of his own drawing—admirable work, less in demand than it should be. Jacques Callot (d. 1635) engraved also many original portraits, but being a man of immense energy, leading a very irregular and adventurous life, he engraved also hundreds of plates of scenery, costume, biblical subjects, and what might be called *genre* in curiously made up sets, of the *Miseries of War*, of *Beggars*, of the *Twelve Months*, and many more. His work was mainly etching, but he never took full advantage of the freedom which that art allows, and a really great etcher he never became. Still, had he possessed more gravity and purpose, no man would have come nearer than he to realize the independent lifelong career of an artist-engraver. He left some 1,400 etchings, while George Cruikshank left 2,500. Should the community care for graphic art as much as it does for literature, it would find its needs well supplied by such men as these, for it would give them fitting subjects and encouragement to do their best instead of their slightest and hastiest.

A great change was now going on in the position of engraving in the world, one which was destined to lead to 200 years of mere copying. The great painter Rubens brought around him a number of very able technical engravers, and undertook to show them how to interpret his numerous pictures into black and white. The two brothers Bolswert, Vorsterman, Paul Pontius, and Peter Soutman are the best known among these able workmen, and to these should be added Jan Müller, as one of the most successful engravers after Rubens, though it is not known that he worked under that artist's immediate influence. The prints of these men have a great interest; they are in many ways right as renderings into one art of another and more rich and varied one, but they have this painful character, that they brought a great influence to bear on the side of copying as the only mission of the engraver. Another curious abuse in the art is to be seen in connection with the famous etchings of portrait heads by Antony van Dyk. That great painter undertook to etch the heads, and perhaps part of the dress, of a series of rather large and showy portrait-engravings, and other and inferior hands were to put in backgrounds and the like. Prints from many of these plates exist. Those taken from the unfinished plate, when, indeed, only the completely modeled head and slight indications of the body and dress are given, are most lovely and precious works of art; the mechanically finished portraits have but slight value. There were other able original portraitists at this time. Leon Gaultier, who died the same year as Van Dyk (1641), was one of them.

Good tendencies were at work, as well as bad; and the greatest of all original etchers was contemporary with Van Dyk, though destined to outlive him by nearly thirty years—Rembrandt, a master in portraiture as in everything that he touched. Cornelis Visscher (d. 1670) was another original portraitist, a burin-engraver, and a good one. As skillful, if less vivid and picturesque, was Robert Nanteuil (d. 1678), whose most famous portraits were engraved after Mignard and other painters, though the greater number of his works are original. In his hands the rendering of textures, as of armor, silk, and fur, reached great perfection. His contemporary, Wenceslaus Hollar, is one of the greatest of engravers, capable of anything, and yet his work looks archaic and incomplete to us, because he never invests it with full light and shade, but devotes himself to exact form, local color, and the study of texture and surface. Another contemporary was Claude Lorrain, the author of but a few etchings, but some of those of admitted excellence. The first English engraver of prominence was William Faithorne, who died in 1691.

The great school of French portrait-engraving was continued by Antoine Masson (d. 1700), G. Audran (d. 1703), and Gerard Edelinck (d. 1707), men worthy to rank with Visscher and Nanteuil, and by Pierre Drevet (d. 1738), and his son, Pierre Imbert Drevet, who died young, only a year later than his father. These are the great masters of seventeenth-century engraving. Their technical skill has never been excelled, and probably can not be; and their sense of keeping of the artistic proportion of all parts of a picture was greater than that of earlier men had been, so that even the most elaborate details keep their place in the composition. Portrait-engraving can hardly equal this hereafter. The day of rich and picturesque costume is gone, and it will not suffice for fine pictorial composition to have heads and hands alone of any interest, while costume, instead of a help, is almost wholly an incumbrance and a puzzle.

If any man could make a success of portrait-engraving under such untoward conditions it would be William Hogarth, who had around him, indeed, men and women more picturesquely dressed than those of the nineteenth century, but who took deliberately for his subject, not the elegant and graceful, but the rough and unseemly side of life. A good engraver, steadily at work at large and crowded plates, his example might have built up a popular use of engraving as a popular and accessible original art; but the epoch was not an artistical one. Another attempt, far removed from Hogarth's in spirit, but equally a popularizing of fine art by means of engraving, was that of Giambattista Piranesi (d. 1778) in his immense production of studies of Roman ruins; but Piranesi was far from being a faultless master of his art of etching, and his chosen subject could hardly be a popular one, limited as it is almost wholly to picturesque ruins and antique sculpture. Étienne Ficquet (d. 1794) may be considered the last of the French portrait school; his minute and delicate handling has preserved for us admirable studies of famous men and women of his time. Giovanni Volpato (d. 1803) was a skilled but uninventive workman, who did work to order from paintings and antiquities at Rome, and kept a school for engravers. Francesco Bartolozzi was fortunate in gaining the favor of influential persons in England, and perhaps owed this to the soft and delicate texture of the stipple-engraving which he practiced. A stronger man and a better artist was Charles Clément Bervic (d. 1822). His work, indeed, was chiefly reproducing the paintings of others, but he brought a fresh and original spirit to the task, and the great museum made by the first Napoleon at Paris gave him exceptional opportunities, as, for instance, the engraving of the Laocoon group from the marble, of which he made what is considered his masterpiece. A Spaniard of singular genius was Goya. Though not eminent as an engraver he must still be mentioned here as one of the men who, in untoward circumstances, were original and individual artists in an art almost wholly given up to copying.

The term *painter-engraver*, taken from the French *peintre-graveur*, has been applied to those engravers who carry out their own designs in their own art. These men and their work should undergo a wholly different criticism from those whose lives have been spent in reproduction only. The copyists have need of great and special ability, no doubt, in translating color into black and white by means of the graving-tools, but the painter-engraver is a man of a different class. What we have to add to this brief historical sketch is some mention of the attempts in the nineteenth century to give new life to engraving by artists of ability who have chosen to express themselves in this language.

David Wilkie is such an artist, and his few etchings and dry-points have a peculiar value of their own. But, though famous as a painter, he could never get people to look at his prints, and they are few and small. J. M. W. Turner in his great *Liber Studiorum* combined his own work with that of other engravers, and left about eighty compositions of wholly exceptional merit, where design and means of expression are perfectly well balanced, and nothing is lacking but the possibility of getting a proper number of prints from the mezzotinted plates. Charles Méryon was one of the most powerful of painter-engravers, and his few important plates contain a body of art-work beyond what would seem possible in such narrow space and severe limitations. Jean François Millet in his few larger etchings gives much of the noble pathos of his paintings. Claude Ferdinand Gaillard, who deserves the credit of having done, after four centuries of engraving for printing, something really new in the art, has produced the most remarkable finished portraits of the century. Jules Jacquemart (d. 1880) was one of the two or three great masters of the art of rendering truths of texture, light and shade, and delicate form; his etchings from the magnificent treasures of the Louvre (*Gemmes et Joyaux de la Couronne*) can hardly be equaled by any one who may follow him, and he etched many plates only second in importance to these. James Whistler has been called by an excellent judge the greatest etcher in line who has ever lived, excelling in this respect, in the force and right usage of the etched line, even Rembrandt himself. Francis Seymour Haden, though of far less originality and force, is one of the most skilled and accomplished of etchers, and has produced a great amount of attractive landscape. Alphonse Legros, less technically skillful, has a high and peculiar rank as artist, and has been called "an old master, belated." Finally, Leopold Flameng, Charles Albert Waltner, and Paul Rajon (d. 1888) must be mentioned as etchers who have pushed the art of reproducing other men's works beyond what had ever been known in true insight and faithfulness of rendering one art by another.

For a very complete list of works on engraving down to 1862, see Georges Duplessis, *Essai de Bibliographie contenant l'indication des ouvrages relatifs à l'histoire de la gravure et des graveurs.* For general reference to prints, description, cataloguing by means of numbers, etc., see the following: F. T. Palgrave, *Essay of the First Century of Italian Engraving*; J. D. Passavant, *Le Peintre-Graveur*; A. P. F. Robert Dusmenil, *Le Peintre-Graveur Français*; François Brulliot, *Dictionnaire des Monogrammes, Marques Figurées, Lettres, Initiales, etc.*; Adam Bartsch, *Le Peintre-Graveur* (Vienna, 1803–21; also later edition, not changed). For biographies of the engravers and of the painters, etc., whose works have been rendered by engraving, see Michael Bryan, *A Biographical and Critical Dictionary of Painters and Engravers* (new ed. revised by Robert Edmund Graves); *Nagler's Künstler Lexicon* (Munich, 1835–48, now scarce; a new edition has been begun under the direction of Dr. Julius Meyer, but the numbers are issued very slowly); A. Seubert, *Allgemeines Künstler Lexicon*; Spooner's *Biographical History of Fine Arts*; Beraldi, *Les Graveurs du Dix-Neuvième Siècle.* For general information and guidance in the study of prints, see Heinecken's *Idée Générale d'une Collection complète d'estampes, etc.*; Georges Duplessis, *Histoire de la Gravure en France* (Paris, 1861) and *Les Merveilles de la Gravure* (Paris, 1869); and *The Print-Collector, an Introduction to the Knowledge Necessary for forming a Collection of Ancient Prints* (London, 1848; attributed to the Rev. Joseph Maberly). For the practical work of engraving, see P. G. Hamerton, *Etching and Etchers* and *Graphic Arts*; De Lostalot, *Les Procédés de la Gravure*; Delaborde, *La Gravure*; Léon de Laborde, *Histoire de la Gravure en Manière Noire* (Paris, 1808). A good general and historical account of the art and guide to students is *An Introduction to the Study and Collection of Ancient Prints*, by William Hughes Willshire. Besides these are to be consulted the encyclopædias in different languages; Larousse, *Dictionnaire Universel du Dix-Neuvième Siècle*, and a very great number of monographs, that is, books devoted to the works of individual engravers.

RUSSELL STURGIS.

Engrossing [from Fr. *engrosser*, to write in large letters, to make big : Ital. *ingrossare*; Fr. *gros, grosse* : Ital. *grosso* < Lat. *grossus*, thick, big]: the writing of a deed in proper legible characters. Among lawyers it signifies especially the copying of any instrument or document on parchment or stamped paper. In the English statute law engrossing signified the purchase of large quantities of any commodity in order to sell it again, and was made an offense punishable by forfeiture and imprisonment. This was one of the many restrictions of trade that characterized the economic system of the Middle Ages. The penalties against the engrossing of corn were especially severe and by the statute of Edward VI. the pillory and confiscation followed the third offense. Other statutes of this nature were enacted, but in 1773 they were repealed, though the penal character of engrossing and FORESTALLING (*q. v.*) survived in the common law and was favored by the popular prejudice. In 1844 acts of this sort ceased to be offenses in England and Scotland.

Engstlen (engst'len) **Alp**: a place of resort, just S. W. of Engelberg, canton of Unterwalden, Switzerland. It has an altitude of 6,092 feet, and its beautiful pastures, with the neighboring lake, Engstlensee, the Wunderbrunnen (an intermittent spring), the falls of the Engstlenbach, the glaciers near at hand, and the loftier snow-clad peaks around, render it very attractive to tourists.

Eng'ström, JOHAN: a Swedish poet, novelist, traveler, and physician; b. Apr. 7, 1794, at Kärnebo, in the government of Kalmare; received his medical license in 1818, and until 1825 was employed as an army surgeon. Author of *Resa genom Norrland och Lappland* (1834); *Resa genom Södra Lappland, Jemtland, Trondhem och Dalarne* (1835–36); *Nordiska Dikter af Eivin* (1821); *Eols Harpan* (1830); *Förbundsbröderna* (1833–34); *Nybyggaren* (1838); *Björn Ulftand* (1840), etc. D. in 1870.

Enharmonic [from Gr. ἐναρμονικός, in accord; ἐν, in + ἁρμονία, harmony]: in music, one of the three genera (chromatic, diatonic, and enharmonic) of ancient music. The enharmonic genus of the Greeks was distinguished by the use of small intervals or quarter tones. In modern music, intervals much less than a semitone owe their origin to the slight difference of pitch which the same (nominal) note takes according as it is adjusted to one or another fundamental note or *tonic*. Thus C ♯ and D ♭ are, at least on keyed instruments, practically the same note, though strictly the former should be produced by $\frac{15}{16}$ of the whole string sounding; the latter by $\frac{9}{10}$. The passage from one to another of these intervals is called an "enharmonic change," and a change of key so effected an "enharmonic modulation."

Enigma [Gr. αἴνιγμα, riddle, dark saying; cf. αἶνος, tale]: an obscure question, a riddle; a proposition put in obscure or ambiguous terms to puzzle or exercise the ingenuity in discovering its meaning. Formerly it was deemed a matter of such importance that Eastern monarchs sometimes sent embassies for the solution of enigmas. Among the famous enigmas of antiquity were that which Samson proposed to the Philistines and that which the Sphinx propounded to Œdipus. See SPHINX.

Enim, or **Enin**: one of the forms of the EL DORADO myth (*q. v.*). It was supposed to be an immensely rich country, somewhere on the tributaries of the upper Amazon. One Francisco Bohorquez, a lying adventurer, declared in 1635 that he had actually been in this country and seen its king, who dwelt in a palace studded with gold and precious stones.

H. H. S.

Enkhuizen, enk-hoi'zen: a fortified seaport-town of the Netherlands; province of North Holland; on the Zuyder Zee; 30 miles N. E. of Amsterdam (see map of Holland and Belgium, ref. 4–G). It has a fine town-hall, several churches, a cannon-foundry, and several ship-building yards. Butter, cheese, timber, and fish are exported. The town was founded in 1200, and was sometimes called Enchusa. It was once a place of 40,000 inhabitants, and had a great herring-fleet, but the silting up of its harbor has wrought its decay. It still has a fine appearance from without. Its town-house, built in 1588, and the Westerkerk are the most remarkable buildings. Here Paul Potter, the great painter, was born in 1625. Pop. 5,900.

En'na: an ancient city of Sicily; near the center of the island, on a lofty hill, almost inaccessible, except at a few points. It was a place of great importance. Its site is now occupied by the decayed town of Castro Giovanni. Enna was a seat of the worship of Demeter, and the shore of a small lake near by was the scene of the mythical rape of Persephone, a favorite subject with poets and artists. Few remains of the ancient city survived the ravages of the Greek, Punic, Roman, Arabian, and Norman conquests.

En'neagon [from Gr. ἐννέα, nine + γωνία, angle]: a plane rectilineal figure having nine sides and angles. The area of a regular or equilateral enneagon is approximately 6·18182 times that of the square of one of its sides.

Enneking, JOHN JOSEPH: See the Appendix.

Ennemoser, en'ne-mō-zer, JOSEPH, M. D.: writer on physiology and animal magnetism; b. in the Tyrol, Nov. 15, 1787. He fought against Napoleon in 1813 and 1814, and graduated as M. D. at Berlin in 1816. He became Professor of Medicine at Bonn in 1820, and removed in 1841 to Munich, where he practiced with success. Among his works are *Der Magnetismus im Verhältniss zur Natur und Religion* (1842; 2d ed. 1853) and *Geschichte des tierischen Magnetismus* (1844), the first volume of which (the *History of Magic*) was translated into English by William Howitt (1854). D. in Egern, Sept. 19, 1854.

En'nerdale Lake: a picturesque sheet of water in the mountain region of Cumberland, England. 7 miles N. E. of Egremont. It is an expansion of the river Eken, 2½ miles long and less than a mile wide.

Ennis: market-town of Ireland; capital of the county of Clare; on the river Fergus; 20 miles W. N. W. of Limerick (see map of Ireland, ref. 10–D). It has a classical school called Ennis College founded in 1689, and the ruins of an abbey founded in 1240; also an asylum for lunatics, an infirmary, a hospital, a public library, a fine court-house, a brisk trade, and some manufactures, and a colossal statue of O'Connell by Cahill. Four bridges cross the Fergus, and railways extend to Limerick and Athenry. Ennis is one of the see-towns of the diocese of Killaloe (Roman Catholic). Pop. 6,300.

Ennis: city; Ellis co., Tex. (for location of county, see map of Texas, ref. 3–I); situated on railway, 34 miles S. by E. of Dallas; in a good cotton region; has a fine school, a very large cotton-compress, etc. Pop. (1880) 1,351; (1890) 2,171; (1900) 4,919. EDITOR OF "COMMERCIAL RECORDER."

En'niscorthy: market-town of Wexford, Ireland; on the river Slaney; 14 miles N. N. W. of Wexford (see map of Ireland, ref. 12–I). It has a fine Roman Catholic church, and a stately Norman castle many centuries old, but still entire. It has a large trade in grain, is at the head of barge navigation, is connected by railway with Dublin and Wexford, has a convent, five churches and chapels, and an asylum for lunatics. Enniscorthy was captured by Cromwell in 1649, and the Irish rebels took it by storm and burned it down in 1798. Pop. 5,660.

En'niskillen: a municipal borough of Ireland; capital of the county of Fermanagh; finely situated on the river Erne, which connects the Upper and Lower Lough Erne, about 75 miles W. S. W. of Belfast (see map of Ireland, ref. 5–G). It has 2 barracks, 6 churches and chapels, a prison, an infirmary, tanneries, straw-hat works, markets for flax, corn, pork, and butter, 2 forts, a linen-hall, and manufactures of cutlery. There are handsome mansions and beautiful scenery in the vicinity. The people of Enniskillen warmly supported the Protestant cause in 1689, when the troops of William III. here defeated those of James II. It is connected by railway with Dundalk, Londonderry, and Bundoran, and steamers ply on the Erne. Pop. 5,700.

Enniskillen, EARLS OF (1789): Viscounts Enniskillen, 1776; Barons Mountflorence (Ireland, 1760); have seats in Parliament as Barons Grinstead (United Kingdom, 1815).—WILLIAM WILLOUGHBY COLE, third earl, D. C. L., LL. D., F. R. S.; b. Jan. 25, 1807, and succeeded to the title of his father, John Willoughby Cole, in 1840. He was educated at Oxford, and before 1840 was distinguished in the House of Commons as Lord Cole, and acted in the Conservative interest. D. without issue, Sept. 5, 1886, and was succeeded by LOWRY EGERTON COLE, fourth earl; b. in 1845.

En'nius, QUINTUS: Roman poet; often called the Father of Latin Poetry; b. B. C. 239, at Rudiæ, a town in Southern Italy, not far from Tarentum. Greek was his native tongue, to which he early added a knowledge of Oscan and Latin. While in military service under the Romans in Sardinia, in 204 B. C., he met Cato, and by him was taken to Rome. Here he supported himself by teaching the Greek language, and adapting Greek plays to the Roman stage. He enjoyed the favor of the elder Scipio Africanus and of other distinguished men. In 189 M. Fulvius Nobilior, the consul, took him with him to his province Ætolia to be the herald of his deeds. For this service the son of Fulvius granted Ennius Roman citizenship in 184. In 169 he died of gout. A writer of great power and versatility, he contributed largely to the formation of the national literature of Rome. His most important work was an epic poem entitled *Annales*, treating in eighteen books the history of Rome, from the landing of Æneas down to his own times. This remained for a long time the most popular poem in the language, and was superseded only by Vergil's *Æneid*. Ennius also wrote tragedies, comedies, and satires. His poetry was greatly admired by Lucretius and by Cicero, who often quotes him. Of all his works only fragments remain. See editions by Vahlen (Leipzig, 1854), and Lucian Mueller (St. Petersburg, 1885), and Sellar, *Roman Poets of the Republic*, chap. iv.

M. WARREN.

Enno'dius, MAGNUS FELIX: a Latin writer; b. in Gaul in 474, of excellent family, and Bishop of Pavia from about 513 until his death in 521. His most important works are a biography of his predecessor, Epiphanius, and a turgid panegyric on Theodoric, written about 507. Also extant are a collection of his letters, two books of *Carmina* on various subjects, and twenty-eight speeches, including school debates. See the editions by W. Hartel (Vienna, 1882) and F. Vogel (Berlin, 1885). M. W.

Enns, or **Ens** (anc. *An'isus*, or *An'esus*): a river of Austria; rises in the crown-land of Salzburg, 12 miles S. of Radstadt. It flows through Styria, forms the boundary between Upper and Lower Austria, and enters the Danube 11 miles below Lintz. Length, about 190 miles, only the last 20 of which are navigable.

Enns (anc. *Laureacum*): town of Austria; on the Danube; at or near the mouth of the Enns; about 96 miles W. of Vienna (see map of Austria-Hungary, ref. 5–D). It has manufactures of iron, steel, and cotton. It was the headquarters of Napoleon in 1809. Pop. (1890) 4,674.

E'noch, or **He'noch** [Heb., initiated or teacher]: the name of five persons mentioned in the sacred books (canonical and apocryphal) of the Hebrews. The second in the order of time, and the most important, was "the seventh from Adam," who "prophesied," and was translated at the age of 365. (Gen. v. 23.)

Enoch, Book of: a book of 108 chapters, forming part of the Apocrypha, quoted by the apostle Jude (vv. 14, 15). It is of uncertain date, critical conjecture ranging from 144 B. C. to 132 A. D., but it was probably written in Hebrew by a Palestinian before the Christian era. The early Christian Fathers used it, but for some centuries only fragments of it were known to European scholars, till in 1773 James Bruce brought home with him from Africa three copies of an Ethiopic version of it, made apparently from the Greek about 350 or 400 A. D. It was published in 1838 at Oxford by Archbishop Laurence, who had previously (in 1821) published an English translation of it, and by Prof. Dillmann (Leipzig, 1851). The latter is the principal edition of the Ethiopic. The best translation which utilizes the newly discovered Greek text is by R. H. Charles (Oxford, 1893). The book contains many curious passages, but its leading idea is that of Divine justice dealing sternly with sinners.

E'nos (anc. *Æ'nos*, or *Ænus*): seaport-town of European Turkey; on the Ægean Sea, at the mouth of the river Maritza (*Hebrus*); 80 miles S. by W. from Adrianople, of which it was the port before the completion of the railway from Adrianople to the neighboring port of Dede-Agatch (see map of Turkey, ref. 4–D). Its harbor admits only small vessels. Pop. about 8,000. Here is a small bay called the Gulf of Enos. *Ænos* is mentioned by Homer in the *Iliad*, book iv.

Enriquez Gomez, ANTONIO, or **Enriquez de Paz**: dramatic author; the son of a converted Portuguese Jew; b. at Segovia, Spain, early in the seventeenth century; entered the army and rose to the rank of captain, but from the year 1629 devoted himself almost exclusively to literary work. About that date several comedies by him were represented on the stage at Madrid with success, and in 1635 appeared his *Fama póstuma á la vida y muerte de Lope de Vega*; but the fear of persecution on account of his alleged return to the Jewish religion drove him from Spain, and in 1638 he appeared in France, where he remained for eleven years. Removing to Amsterdam about 1656, he openly professed Judaism, for which he was burned in effigy at the *auto-da-fe* in Seville, 1660. The date of his death is not known. Twenty-two comedies were written by him and were all received with great favor, although they betray the faults of a facile but careless writer. His *A'lo que obliga el honor*, published with three other comedies under the title of *Academias morales de las Musas* (Rouen, 1642), is said to have suggested Calderon's *Medico de su honor*. The *Siglo pitagórico* (Rouen, 1647; Brussels, 1727) is a work of a somewhat mystical character, containing satirical sketches in prose and verse. Enriquez is thought by some to be the author of the comedies usually attributed to Fernando Zarate. See Ticknor's *History of Spanish Literature*.

Ensiform Cartilage, or **Xiphoid Cartilage** [*ensiform* is from Lat. *ensis*, sword + *forma*, form; *xiphoid* is from

Gr. ξίφος, sword + εἶδος, shape]: in human anatomy, the third and lowest piece of the sternum or breast-bone. It is smaller than either the first piece (*manubrium*) or the second (*gladiolus*). It is of various form, usually more or less dagger-shaped, sometimes perforated, sometimes two-pointed, and is usually cartilaginous until the seventeenth or eighteenth year, when a center of ossification appears in its upper part, and the whole takes on, very slowly, a somewhat bony character.

Ensign [from O. Fr. *enseine*, Mod. Fr. *enseigne* : Ital. *insegna* < Lat. *insig'nia*, emblem, standard, collec. plur. of *insig'ne*; *in*+*signum*, sign]: (1) the national flag or banner carried by a ship of war, and usually hoisted at the peak or on a flagstaff at the stern. Its chief purpose is to indicate the nationality of a ship when it meets another vessel at sea. In the navy of the U. S. the ensign is the national flag. All British men of war since 1864 carry the St. George's ensign—viz., a white ensign with a red cross, and a union jack in the left-hand upper quarter. The British ensign is a red, white, or blue flag, having the union in the upper corner next the mast, red for the merchant marine, white for the navy, and blue for the naval reserve.

(2) In the British army until 1871 the lowest grade of commissioned officers in the infantry, the senior of whom carried the regimental colors or ensign, thus corresponding to *cornet* in the cavalry. Officers of this rank are now called sub-lieutenants. The rank of ensign existed in the colonial militia of New England and in the Revolutionary army. The corresponding rank in the U. S. army is that of second lieutenant. The title of ensign was introduced into the U. S. navy in 1862, taking the place of that of passed midshipman. An ensign of the line is one of the lowest grade of commissioned officers, is a graduate of the Naval Academy, and ordinarily obtains his commission after four years' study on shore and two years of cruising.

Ensilage [Fr. deriv. of *ensiler* = Span. *ensilar*, to commit to a pit, or *silo* < Lat. *sīrus* = Gr. σιρός, pit]: a method of preserving forage plants in a green state; introduced into the Eastern U. S. from France about 1875. The term is also applied to the fodder thus preserved. Ensilaging green crops has become more common in the dairy districts of the U. S. than in France, Great Britain, or Germany. In many cases ensilaging green forage crops is the most economical way of preserving them, but it is not always satisfactory, as there is always some and frequently a large amount of loss of the ensilaged material, which is not infrequently acid or slightly mouldy. Silos may be built of wood, grout, or stone, either above ground or, better, below ground. When built of wood, they decay rapidly; if stone or grout, they are expensive. Rectangular silos are the most common, but circular ones are the best. A silo should be deep, strong, durable, air-tight, and inexpensive, as the material to be preserved is bulky in proportion to its value. The best and cheapest way to construct a silo, though not the most common, is to dig a circular pit 10 to 20 feet in diameter and 12 to 20 feet deep; the dirt thrown out may add 5 feet more to the depth. The sides of the pit are protected by a 4-inch wall of hard brick laid in cement; clay is packed behind the wall as the work proceeds. The top is contracted to about one-half the diameter of the bottom, and is protected by a circular iron flange upon which rests the cover of wood or iron; cement or rubber placed between the lid and flange serves to exclude the air, and earth placed upon the lid keeps out the frost. Great disappointment and loss have frequently resulted from departing from the original methods practiced by the Egyptians, Mexicans, and American Indians in keeping grains and other perishable products in simple earth-pits. The ensilage should be kept at all times at a temperature as low as that of the earth, and in an air-tight silo. The ancient method was to dig a pit in the dry sand, and, when filled, cover and compact the sand to a considerable depth over the mouth of the pit, thereby making a nearly air-tight seal. The methods of constructing and filling silos in the U. S. are very variable, as are also the material ensilaged and the treatment after filling. Sometimes doors are placed at the sides of the silo and removed as the ensilage is used, and sometimes no openings are left, the material being raised to the top by a horse when needed. Some empty the silo from the top, others cut down and feed out a section at a time. Some ensilage the material when it is very immature, others when it is nearly ripe; some fill rapidly to prevent heating, while others fill slowly so that the material may rise to 120° F.; some solidify while filling; some weight (150 lb. to the square foot) with stones, earth, or other material after a covering has been laid on, others simply cover with green weeds, grass, or straw, 1 to 2 feet deep. All these methods are imperfect, as more or less acid and mould are always present and a considerable loss occurs. The perfect silo is one which is absolutely air-tight, and from which all air is extracted after the pit is filled, but it is practically impossible to build one large enough for ordinary uses. The more nearly these conditions are fulfilled the more satisfactory will be the product. Carbonic acid gas suggests itself as a cheap and convenient material for replacing the air in the silo. At the Cornell University experiment station nearly mature green corn has been kept for three months in an air-tight silo filled with carbonic acid gas, buried in the earth, with no rise in temperature, and almost no change in color, taste, or weight. This method, however, is still in its experimental stage.

Many kinds of plants have been ensilaged with greater or less success, but Indian corn is now used most largely. Any broad-leaved dent variety which will ripen or nearly so in a given climate, the large sweet, and, where the season is short, the flint varieties, are now considered to be the leading kinds of ensilage corn. Some growers still sow or drill the seed thickly, but this prevents full development of ears, saccharine and coloring-matter, albuminoids and appetizing aromas. The aim should be to raise the greatest amount of grain possible, as then the greatest feeding value is secured. The corn should be glazed before it is cut, at which time it will contain from 60 to 70 per cent. of water. The best ears are often removed and dried, for, if the crop is good, the ensilage will be too rich in grain for most economical results in the dairy, if all the ears are ensilaged. Fifteen to twenty-five tons per acre may be secured at a cost, for raising and harvesting, of from $1 to $2 per ton.

M. Goffart's *Treatise on Ensilage of Maize*, translated from the French by J. B. Brown; *The Book of Ensilage*, by John M. Bailey; *On Ensilaging of Green Forage Crops in Silos*, by H. R. Stevens, are the leading works on the subject. I. P. ROBERTS.

Enslin, ens'lin, KARL: poet; b. at Frankfort-on-the-Main, Germany, Sept. 21, 1819; educated as a public-school teacher at Esslingen. He published several collections of his poems, which may be counted among the best contributions to juvenile literature in Germany. D. Oct. 14, 1875. J. G.

Ens Mar'tis [Lat., essence of Mars]: an old alchemical name for the ammonio-chloride of iron, formerly, used in medicine. It is an uncertain aperient and chalybeate tonic.

Entablature [adaptation of Ital. *intavolatura*; *in* + *tavola* < Lat. *ta'bula*, table]: in architecture of Greek, Roman, and revived classical styles, the portion of a building resting upon the columns. It consists of architrave, frieze, and cornice. In ordinary building the term is applied to the course of masonry on a wall immediately below the roof. See ORDERS OF ARCHITECTURE.

Entail' [from O. Fr. *entailler*; *en* + *taille*, cut, piece cut off, tax: Ital. *taglio* < Lat. *ta'lea*, or deriv. of *talia're*, to cut]: an estate in fee limited to certain classes of descendants. Thus a fee simple would be regularly created by the word "heirs," as, for example, to "A and his heirs," and would descend to any heirs, however remote. An estate given to A and "the heirs of his body" would be confined to descendants. This is an example of the proper words to create an estate tail. The descent might be still more strictly confined, as to male issue or the issue born of some specified mother. The peculiar features of an entail depend upon a well-known English statute termed *De donis*, the regular effect of which was to confine the property to the specified mode of descent. The result was that the tenant in tail had the general characteristics of owner, except that he could not sell, and that the land could not be seized for his debt. The courts permitted the entail to be destroyed by a fictitious legal proceeding called a fine, and more completely by another like proceeding called a common recovery, instituted in behalf of the tenant. He could thus, if he saw fit, become absolute owner. The common recovery is now abolished by statute in England, and under certain limitations the tenant may resort to a conveyance called a disentailing deed, and thus acquire a fee simple. In the U. S. words constituting an estate tail according to English law will usually be construed to create a fee simple, unless the property is given over to some other person on default of issue surviving the first taker; in which case the secondary gift would be upheld, and would take effect should no issue survive. See PERPETUITY.

En'tasis [Gr. ἔντασις; ἐν + τείνειν, strain, stretch]: a delicate and almost imperceptible swelling out in the taper of the shaft of a column, common in the architecture of ancient Greece. It was adopted to prevent the shafts being strictly frusta of cones, in which case there would, by a simple optical law, be an incorrect impression made upon the eye as to the proportions of the column. It was one of the most delicate yet important of the refinements of Greek architecture, and has not been accurately attained in modern imitations. In the columns of the Parthenon the entasis amounts to $\frac{1}{550}$ of the whole height of the column.

Entel'echy [from Gr. ἐντελέχεια, absoluteness, actuality, deriv. of phrase ἐντέλει ἔχειν, to be complete, or ἐντελής, perfect + ἔχειν, be]: a metaphysical term from the Aristotelian philosophy, denoting the fundamental idea of the whole system. Cicero defined this idea as *energy*, but the Greek philosophers who, in the fifteenth century, moved from Constantinople to Italy—and among them especially Argyropolus—ridiculed him for the definition, and gave *perfection* as the constituent element of the idea. Melanchthon, however, and Leibnitz, and all modern philosophers almost without exception, follow Cicero; and when the "Entelechy" of Aristotle is compared with the "Idea" of Plato or the "Absolute Negativität" of Hegel, or other fundamental ideas of other philosophical systems, it is evident that *energy* covers a much larger part of the Aristotelian idea than *perfection*. The abstract repose of the Platonic Idea is supplanted by the energy of reality in the Aristotelian Entelechy; its potentiality becomes actuality. Aristotle calls truth an idea, but the soul he defines as an ἐντελέχεια. The best explanations of the entelechy and its relations to the whole system of Aristotelian philosophy are given by Brandis in his *Aristoteles und seine Akademischen Zeitgenossen* (Berlin, 1857), and by Thurot in his *Études sur Aristote* (Paris, 1860).

Entellus Monkey, or **Hanuman**: a species of East Indian monkey (*Semnopithecus entellus*) about 2 feet in length, having long limbs and a very long and powerful but not prehensile tail. These monkeys are regarded as sacred by

Entellus monkey.

the Hindus, who dedicate temples to them, and erect hospitals for their benefit. The entellus monkeys exhibit a familiarity bordering on impudence, and often plunder gardens with impunity, as the Hindus feel honored when robbed by them. The Hindus also believe that they are metamorphosed princes, and to kill one is considered a deadly sin; hence these monkeys swarm in many places, especially in the vicinity of the temples.

Enteral'gia [from Gr. ἔντερον, intestine + ἄλγος, pain]: a name given in some medical works to colic, especially of the form attended by spasmodic contractions in the muscular coat of the intestine. See COLIC and NEURALGIA.

Enteri'tis [from Gr. ἔντερον, intestine + suffix of Greek origin *-itis*, applying to names of inflammatory diseases]: an inflammation of the small intestines. The term is somewhat vaguely used by medical writers. Active inflammation of the bowels, in adults at least, is frequently confined, for the most part, to the peritoneal coat, and the disease is then called peritonitis. When the mucous coat of the bowels alone is actively involved, it is frequently a fatal disease in children, but in adults, with care, the majority of cases recover. Catarrhal enteritis is benefited, and often cured, by gentle purgation. But in active disease of this kind cathartics will often greatly aggravate the evil. Such cases are best treated by rest, opiates, poultices to the abdomen, and bland nourishment. "Typhlitis," inflammation of or about the cæcum, when caused by abscess or perforation of the appendix cæci, is not unfrequently fatal; when otherwise caused, recovery may be looked for.

Revised by WILLIAM PEPPER.

Enteropneusta [from Gr. ἔντερον, intestine + πνεῖν, breathe]: a group of animals of very uncertain affinities, constituting one of the main divisions of the CHORDATA (*q. v.*). They have at various times been classed with the echinoderms, with the annelids, and are now usually associated with the vertebrates. They are worm-like in shape, and live buried in the sand of the ocean. In *Balanoglossus*, the principal genus, there is an acorn-shaped proboscis followed by a collar, and behind this the long body. The mouth is below at the base of the proboscis, and the throat is perforated with gill openings, in allusion to which the name Enteropneusta is given. In the proboscis there is a cartilaginous rod of tissue believed to be homologous with the notochord of vertebrates. Some species have a direct development, while others have a larval stage which closely resembles that of the echinoderms. The nineteen known species are distributed into four genera. Allied to them are probably the genera *Cephalodiscus* and *Rhabdopleura*, formerly included among the Polyzoa. J. S. KINGSLEY.

En'thymeme [from Gr. ἐνθύμημα, a consideration, thought, in Aristotle a "rhetorical syllogism," deriv. of ἐνθυμεῖσθαι, consider; ἐν, in + θυμός, soul, mind]: in logic, a syllogism of which one of the three parts (generally the major premise) is suppressed or held in mind—e. g. "The freedmen ought not to vote, because they can not read." According to De Quincey (*Historical Essays*, vol. ii., p. 215, *seq.*), the Aristotelian enthymeme is an argument in respect to matters probable rather than demonstrable. (So also Thomson, *Laws of Thought*, p. 284.) Aristotle's own definition for the rhetorical enthymeme is "a syllogism from probable propositions or from signs." By *probable propositions* he means those which are general, but not at all universal, as "injured men seek revenge." By *signs* he designates facts or marks, such as attend upon other facts or conceptions, so that from the presence of the sign we suspect or know that the thing signified is also present. The rhetorical enthymeme, when based on signs, is always affirmative, taking no account of negative indications. Its results are universal, and may amount to practical or even formal demonstration.

Entomology [from Gr. ἔντομος, cut in pieces (ἐν, in + τεμεῖν, cut; neut. plur. ἔντομα (sc. ζῷα, animals), insects so named from the divisions of their bodies, cf. Lat. *insecta*) + -λογία, discourse]: the department of zoölogy which treats of insects. For the purposes of this article the subject can be treated under three heads: (1) the anatomy of insects, (2) the metamorphoses of insects, and (3) the classification of insects.

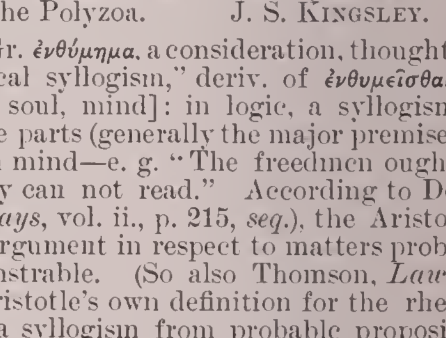


FIG. 1.—Figure of an insect, showing the grouping of the segments into *head*, *thorax*, and *abdomen*.

I. THE ANATOMY OF INSECTS.—*External Anatomy*.—Insects belong to that branch of the animal kingdom known as the *Arthropoda*, which is characterized by having the body composed of a series of segments, and furnished with jointed appendages. In insects the body segments are more or less distinctly grouped into three regions—the *head*, the *thorax*, and the *abdomen* (Fig. 1). The head is composed of at least four segments, which are so completely consolidated as to appear one. The thorax is composed of three segments, designated the *prothorax*, *mesothorax*, and *metathorax* respectively, and bears the organs of locomotion. The abdomen consists typically of eleven segments, but the full number is rarely distinguishable. In some insects (cuckoo-flies) only three or four abdominal segments are visible; but in the greater number of insects eight or nine segments can be distinguished in this region.

The head possesses the eyes, antennæ, and mouth-parts. In adult insects there exists on each side of the head an organ readily recognized as an eye; but when seen with a microscope, it presents an appearance very different from that of the eye of higher animals (Fig. 2). Its surface is divided into many six-sided portions, each of which is found on dissection to be the cornea of a distinct eye. This organ is therefore termed a *compound eye*, and each of the hexagonal divisions is termed an *ocellus*. The number of ocelli in the compound eye varies greatly in different insects; in some ants it is only about fifty, while in a dragon-fly or a butterfly there are many thousands. In addition to the compound eyes, many insects possess *simple eyes*. These vary in number from one to four, and are situated between the compound eyes.

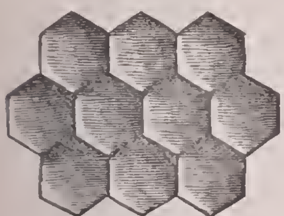


FIG. 2.—Part of compound eye greatly enlarged.

The *antennæ* are a pair of jointed appendages inserted in the head in front of the eyes or between them (Fig. 7, *a*). These are the organs commonly called the feelers. They vary greatly in form; in some insects they are thread-like, consisting of a series of similar segments; in others certain segments are greatly modified in form. In many insects each segment of the antennæ bears one or more appendages, which give the organ a feather-like appearance. The variations in form of the antennæ frequently afford excellent characters for distinguishing the groups of insects. Knowledge of the functions of the antennæ is still very incomplete. Minute structures are found upon them varying in form in different insects, which are doubtless organs of special sense, presumably of smell; and in some insects, as the male mosquito, other organs borne by the antennæ appear to act as organs of hearing. The minuteness of these organs of special sense renders their study very difficult. It is only recently that the methods of histological investigation have been sufficiently perfect to make possible the acquirement of exact knowledge regarding their structure.

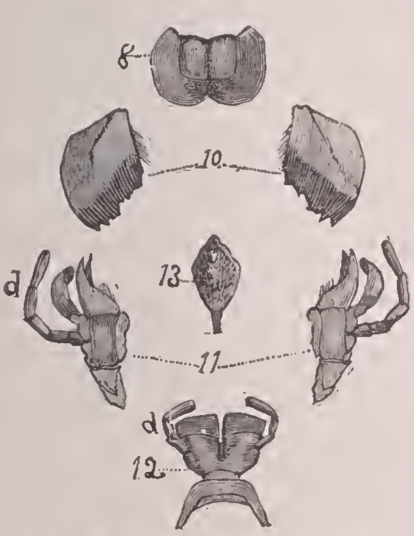


FIG. 3.—Mouth-parts of the red-legged locust: 8, labrum; 10, mandibles; 11, maxillæ; 11 *d*, maxillary palpi; 12, labium; 12 *d*, labial palpi; 13, hypopharynx.

The *mouth-parts* of insects are complicated organs consisting of several pairs of highly specialized appendages. The typical structure of the mouth-parts is best seen in the biting insects (Fig. 3). Here we find an upper lip, the *labrum*, an under lip, the *labium*, and two pairs of jaws, the *mandibles* and *maxillæ*, acting horizontally between them. Each mandible usually consists of a single stout piece which may be furnished with tooth-like processes fitting it for chewing or for seizing prey. The maxillæ or lower pair of jaws are much more complicated organs consisting of several pieces; each maxilla bears an organ consisting of several segments, the *maxillary palpi*; the lower lip is also a complicated organ, being formed of a pair of jaws grown together on the middle line. It bears a pair of jointed appendages, the *labial palpi*. There may be also within the mouth one or two tongue-like organs, the *epipharynx* and the *hypopharynx*. This type of mouth-parts is greatly modified in the different orders of insects. Thus the maxillæ of a butterfly are greatly developed, forming the well-known sucking tube of these insects; while the other parts, except

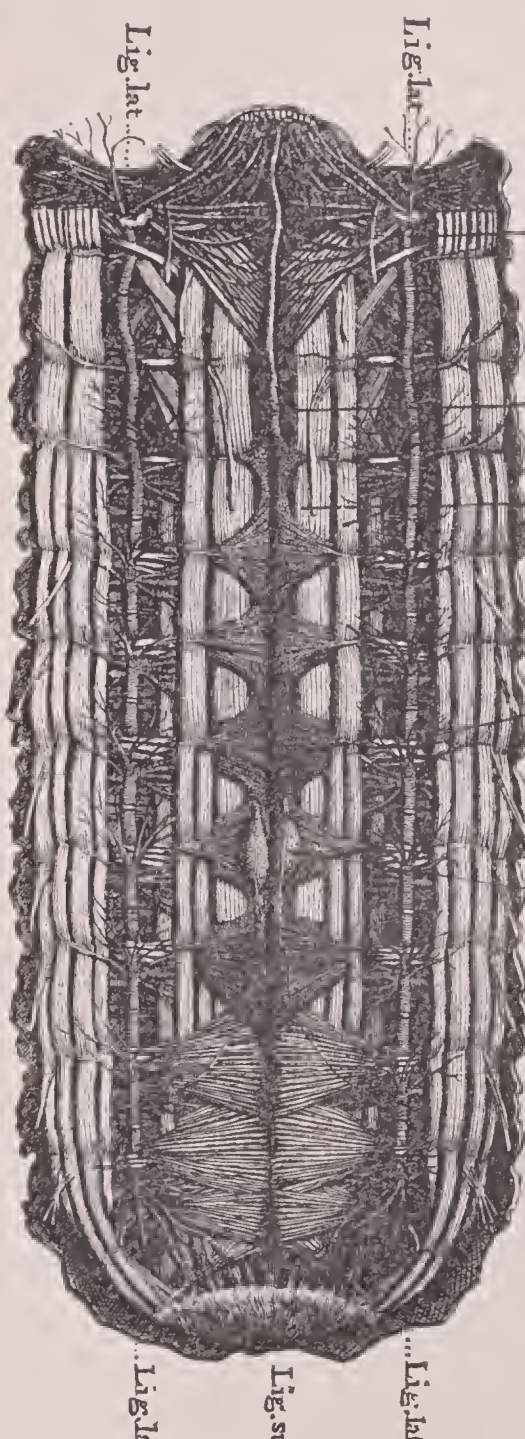


FIG. 4.

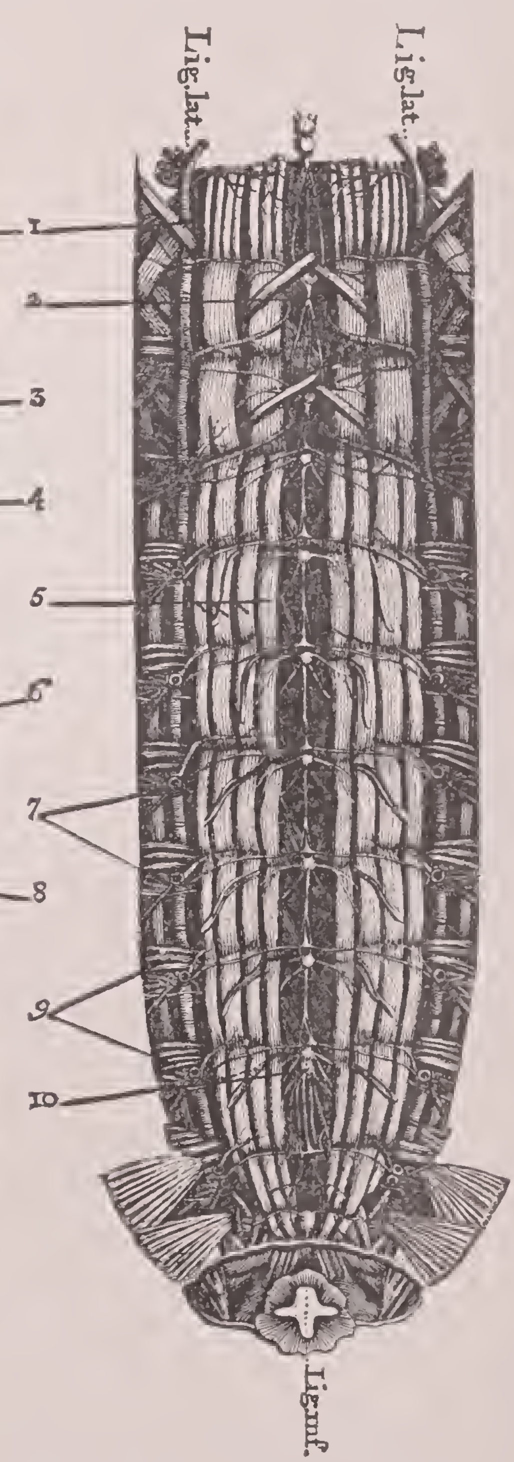


FIG. 5.

A caterpillar (*Cossus ligniperda*). (After Lyonet.)

FIG. 4.—Caterpillar opened on the ventral middle line. FIG. 5.—Caterpillar opened on the dorsal middle line. 1, principal longitudinal tracheæ; 2, central nervous system; 3, aorta; 4, longitudinal dorsal muscles; 5, longitudinal ventral muscles; 6, wings of the heart; 7, tracheal trunks arising near spiracles; 8, reproductive organs; 9, vertical muscles; 10, last abdominal ganglion.

the labial palpi, are but little if at all developed. In the flies and bugs the mandibles and maxillæ are bristle-like, fitted for piercing, and form with the lower lip an organ for sucking.

The appendages of the thorax are the organs of locomotion; these consist of the legs and wings. Of the former there are three pairs, of the latter never more than two pairs. Each segment of the thorax bears a pair of legs; the wings are borne by the second and third segments. Each leg consists of the following parts: coxa, trochanter, femur,

Fig. 6.—Leg of May-beetle, showing relation of skeleton and muscles.

tibia, and tarsus. The *coxa* is the segment by means of which the legs are joined to the body. The *trochanter* is the next division of the leg, and is usually an inconspicuous part; in certain *Hymenoptera* it consists of two segments. The *femur* is the principal segment of the leg. Following the femur is the *tibia*, consisting of a single segment. The remaining segments of the leg, varying in number from one to six, compose the *tarsus* or foot. The last segment of the tarsus is furnished with one or two claws.

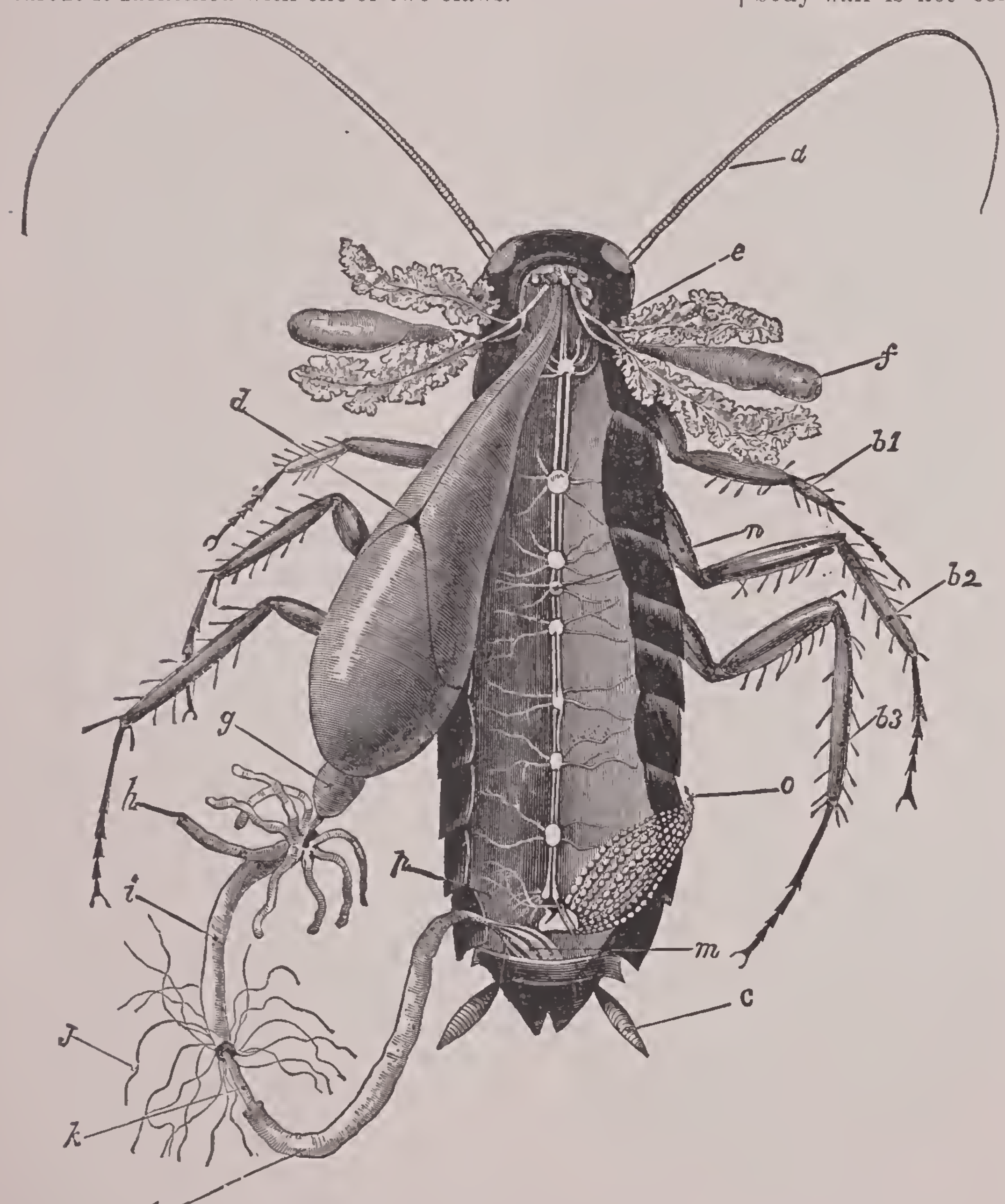


Fig. 7.—A cockroach (*Periplaneta orientalis*). (From Rolleston.)
a, antennæ; *b1*, *b2*, *b3*, tibiæ; *c*, anal cerci; *d*, ganglion on recurrent nerve upon the crop; *e*, salivary duct; *f*, salivary bladder; *g*, gizzard; *h*, hepatic cœca; *i*, chylific stomach; *j*, Malpighian vessels; *k*, small intestine; *l*, large intestine; *m*, rectum; *n*, first abdominal ganglion; *o*, ovary; *p*, sebaceous glands.

Although the normal number of wings is two pairs, many insects have only a single pair, and other insects are wingless. When but a single pair of wings is present it is almost invariably the first. Each wing is a plate-like or membranous expansion, which is at first developed as a sac-like projection of the body wall. The wing is usually strengthened by a firm network of thickened lines. These are termed the veins or nerves of the wing, and their arrangement, described as the venation or neuration of the wing, affords useful characters for determining the affinities of insects. Consequently, special names are given to the different veins and also to the cells, as the thin spaces circumscribed by the veins are termed.

Except in the first order of insects (*Thysanura*), the abdomen of the adult bears no locomotive appendages. But many larvæ have fleshy appendages which aid in locomotion; these are termed *prolegs*. In the adults the caudal end of the body is furnished with jointed filaments, the *cerci* and *caudal setæ* (Fig. 7, *c*). Frequently also the body is furnished in the males with organs for clasping, the *claspers*, and in the females with saws, pincers, or borers, the *ovipositor*. In the females of certain insects there is a sting, a modified ovipositor, which is used as an organ of defense, and the abdomen of plant-lice and certain other insects bears a pair of tubes or tubercles, through which honey-dew is excreted.

Internal Anatomy.—The outer wall of insects is more or less firm, being hardened by a horny substance termed *chitine*; this outer wall serves as a skeleton within which are the muscles and viscera. The *skeleton* is therefore in general outline a hollow cylinder. This hardening of the body wall is not continuous, but takes place in a series of more or less regular ring-like bands, that have the well known segmented appearance characteristic of insects and the animals closely allied to them. Between the horny ring-like segments the body wall remains soft and flexible. In this way provision is made for the various motions of the body. The movement of the legs, antennæ, and certain other appendages is provided for in the same way; each one is a cylinder made up of several segments, and between the segments the wall of the cylinder remains flexible. Although the skeleton of an insect is chiefly an external one, there are prolongations of it into the body cavity. As these form support for various organs, and attachment for many muscles, they are often described as the internal skeleton.

The *muscular system* of insects is composed of immense numbers of distinct isolated straight fibers, which are always free (i. e. not inclosed in tendinous sheaths as with Vertebrates). As a rule, the muscles that move the segments of the body are not furnished with tendons (Figs. 4 and 5), while those that move the appendages are thus united at the distal end (Fig. 6). In appearance the muscles are either colorless and transparent or yellowish white, and are of a soft, almost gelatinous consistence. There are several layers of muscles lining the body wall or external skeleton (Figs. 4 and 5). These provide for the movements of the body and its appendages, and constitute the chief part of the muscular system.

The *alimentary canal* is a tube passing from the mouth to the caudal end of the body; in its simplest form it is a straight tube occupying the axis of the cylindrical body. But usually it is longer than the body, and is consequently more or less convoluted; moreover, it is not of uniform structure, but, as in higher animals, different parts are adapted to different functions. The names applied to these parts are similar to those used in the anatomy of higher animals (Fig. 7).

The *circulatory system* of insects is an open one, the blood flowing in vessels during only a part of its course. The greater part of the circulation of this fluid takes place in the cavity of the body and its appendages. The only blood-vessel that exists in these animals lies just beneath the body wall above the alimentary canal (Fig. 4, 3). It extends from near the caudal end of the abdomen through the thorax into the head. That part of this vessel that lies in the abdomen is termed the heart, and consists of a series of chambers, corresponding to the segments of the body. The number of these chambers varies, but there are rarely more than eight. The chambers of the heart are separated by valves which permit the blood to flow only toward the head. There is in the wall of the heart a pair of lateral openings corresponding to each chamber; these also are furnished with valves which admit the blood to the heart, but prevent its exit. When, therefore, the chambers contract a stream of blood is forced toward the head, and when they expand the blood rushes into them through the lateral openings. The prolongation of the heart extends through the thorax and into the head near the brain, where it is usually somewhat branched. The branches are very short, and the blood passes from them directly into the body cavity. Here it bathes the viscera, receiving the products of digestion from the alimentary canal, giving up to the various glands their secretion, and carrying nourishment to all parts of the body. In its course through the body the blood flows in regular channels without walls, like the currents of the ocean.

The *blood* is usually colorless or slightly tinged with green, but its circulation is made conspicuous by the movements of the large corpuscles in which it abounds. In transparent insects it can be seen pouring forth from the cephalic end of the aorta, bathing first the brain and then passing to all parts of the body, even out into the appendages. By tracing the course of any one of these currents it will be found to flow sooner or later to the sinus in which the heart rests, and from which it receives its blood.

The central part of the *nervous system* (Fig. 5, 2; Fig. 7, *n*) consists of a ganglion in the head above the œsophagus, and a series of ganglia, typically one for each segment of the body, lying on the floor of the body cavity, and connected by two longitudinal cords. In the head one of these cords passes on each side of the œsophagus from the brain to another ganglion in the head below the œsophagus, thus forming a nervous collar about the alimentary canal. From each ganglion nerves arise, which supply the adjacent parts, and from the thoracic ganglia nerves extend to the legs and wings. This series of ganglia is really a double one; but each pair of ganglia is more or less closely united on the middle line of the body, and often appears as a single ganglion.

In connection with the nervous system reference should be made to the special senses of insects. Although, as has already been stated, comparatively little is known regarding the organs of special sense, it is probable that insects possess the five senses known to us, and perhaps they have others the nature of which we can not conceive. Even in the case of the five senses the range of perception may be very different from ours. Thus Lubbock has shown that ants perceive the ultra-violet rays which are invisible to us. There is, however, a great variation in the degree of development of different senses in different insects; for example, some are furnished with wonderful eyes, while others are blind. It is probable that in many cases the great development of one sense is correlated with a slight development of some other. As an illustration, we find that in the dragon-flies and cicadas, which are essentially directed by sight, the antennæ are rudimentary, and doubtless the same is true of the sense of smell. During the night these insects are passive, while during the day they trust to their powers of sight, or possibly also to hearing, as would seem to be the case with some of the cicadas. The best-known organs of special sense are the eyes; regarding the structure of these several very elaborate monographs have been written.

The most striking peculiarity in the structure of insects is presented by the *respiratory system.* If an insect be carefully examined there will be found along the sides of the body a series of openings. These can easily be seen in many caterpillars and other larvæ; they are the openings of the respiratory system, and are termed the *spiracles.* The number of spiracles varies greatly in different insects. There is, however, never more than one pair on a single segment of the body. They do not occur on the head (except in certain *Thysanura*), but are borne by each of the thoracic segments and by the first eight abdominal segments. Thus there are eleven segments that may bear spiracles, but one or more always lack them. The spiracles are either simple openings in the respiratory system, or are provided with valves, sieves, or fringes of hair for the exclusion of dirt. They lead into a system of air-tubes termed *tracheæ* (see 1 and 7 of Figs. 4 and 5). There is a short trunk arising from each spiracle; these are all connected together by a large longitudinal trunk on each side of the body, and by numerous transverse trunks. From these large tracheæ there arise a great number of smaller ones, which branch and subdivide, and extend to all parts of the body. The smaller branches of the tracheæ are exceedingly minute, and are intimately associated with the various tissues. By means of these fine tracheal trunks the air is carried to the various tissues, so that they are supplied with oxygen directly from the air without the intervention of blood as in higher animals. Although insects are, strictly speaking, air-breathing animals, many of them live in the water. Some of these have provision for carrying about with them a supply of air which they renew from time to time. Others are furnished with gill-like organs termed tracheal gills.

In insects the sexes are distinct. The *reproductive organs* vary greatly in form, but agree in general characteristics. They are contained in the abdomen, are paired, and usually open by a common duct near the caudal end of the body. One of the ovaries of a cockroach is represented at *o* in Fig. 7.

All insects are developed from eggs. But there are some apparent exceptions. Thus many flies retain their eggs until after they are hatched, if a proper place for laying them is not found earlier, and in some flies (the *Pupipara*) the young attain a considerable development before they are born. In the plant-lice (*Aphididæ*) there is a remarkable alternation of reproduction by budding with the sexual reproduction.

II. The Metamorphoses of Insects.—*Complete Metamorphosis.*—From the egg of the butterfly there emerges a worm-like creature, known as a *caterpillar*, which has upon superficial examination very little in common with its parents. This caterpillar eats and grows, and when fully grown changes to an oblong, apparently lifeless object, the *chrysalis.* After a time there bursts forth from this chrysalis a butterfly, like that which produced the egg. In a similar way from the egg laid by a fly upon a piece of meat there hatches, not a fly, but a footless, worm-like maggot. This when fully grown changes to a quiescent object corresponding to the chrysalis of a butterfly. Later from this object there escapes a winged fly like that which laid the egg. Those insects which, like the butterflies and flesh-flies, bear almost no resemblance in form to the adult insect when they emerge from the egg, are said to undergo a complete metamorphosis. In other words, the change of form undergone by the insect is a complete one.

Incomplete Metamorphosis.—There are, however, many insects which after leaving the egg do not undergo such a remarkable change of form as that indicated above. A young grasshopper just out of the egg can be easily recognized as a grasshopper. It is, of course, much smaller than the adult, and is not furnished with wings. Still the form of the body is essentially the same as that of the adult. After a time rudimentary wings appear, and these increase in size from time to time until the adult stage is reached. During this development there is no point at which the insect passes into a quiescent state corresponding to the chrysalis state of the butterfly. Those insects, like the grasshoppers, which when they emerge from the egg resemble the adult are said to undergo an incomplete metamorphosis. In other words, after leaving the egg they do not undergo a complete change of form.

Molting, Exuviæ.—The body wall of an insect is rendered more or less hard by the deposition within its cuticular layer of a horny substance known as chitine. The result of this hardening of the skin is to render it inelastic. Consequently, as the body of an insect increases in size its skin becomes too small for it. When this occurs a second soft skin is formed beneath the outer hard one. Then the outer skin splits open, usually along the back, and the insect works itself out from it. The new skin, being elastic, accommodates itself to the increased size of the body. In a short time this new skin becomes hardened, and as the insect grows it in turn is cast off. This shedding of the skin is termed *molting*, or *ecdysis.* The cast skins are sometimes referred to as the *exuviæ.* The number of molts varies greatly in different groups of insects. In Fig. 9 is shown the cast skin of a dragon-fly clinging to a reed.

The Egg.—The egg is the first of the four principal stages through which an insect passes in the course of its development. In a few instances the egg is retained within the body of the female until after it is hatched; in this case the insect is said to be *viviparous.* The eggs of insects vary greatly in their external characters. While many of them are furnished with smooth oval shells, in others the shells are beautifully ribbed or pitted (Fig. 10), or furnished with spines or other appendages. There exists also in one end of the egg of an insect one or more pores known as *micropyles*; through these the spermatozoa pass into the egg and thus fertilize it.

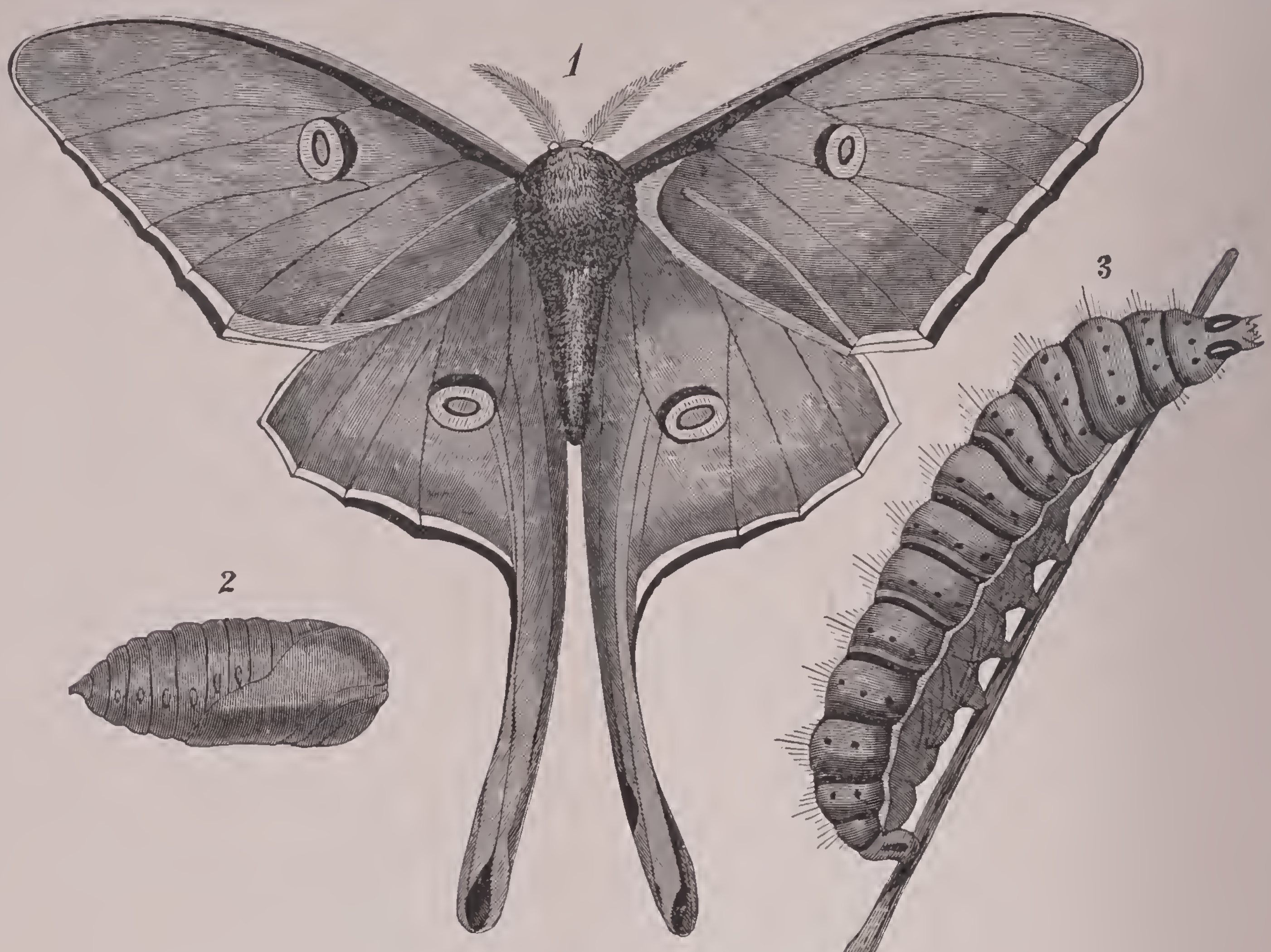


Fig. 8.–Luna moth, *Actias luna*: 1, Imago; 2, Pupa; 3, Larva.

The Larva.—The larva is the second of the four principal stages in the life of an insect. It is the stage in which the insect emerges from the egg. Familiar examples of larvæ are caterpillars, maggots, grubs, etc. (Fig. 8, 3). It is during the larval state that the growth of the insect is made, and consequently in this stage nearly all the molts are undergone. The molts subsequent to this period are simply those made when the insect changes from one stage to another.

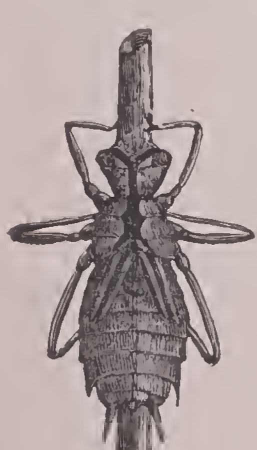


Fig. 9.—Exuviæ of a dragon-fly.

Nearly all of the creatures commonly known as worms are not true worms, but are the larvæ of insects. Away from the seashore but few worms are known to other than zoölogists; these are earth-worms, leeches, hair-worms, and the various species parasitic in the bodies of higher animals. The many worm-like animals found feeding upon the tissues of plants, as tomato-worms, apple-worms, etc., are the larvæ of insects. Other larvæ of insects are predaceous or parasitic.

The Pupa.—The pupa is the third of the four stages in the life of an insect. In this stage the insect is usually quiescent. But a few pupæ, as those of mosquitoes, are active. The change from the larval to the pupa state is made by molting the skin of the fully grown larva. In the pupa the legs and wings of the adult are represented in a rudimentary state. In the pupæ of butterflies and moths these organs are closely fastened to the breast of the insect (Fig. 8, 2), while in the pupæ of bees, wasps, and beetles they are free.

Chrysalis.—The term chrysalis is applied to the pupa of a butterfly. This name was suggested by the bright, metallic spots with which the pupæ of certain butterflies are marked. Two forms of this word are in use: chrysalis, plural chrysalides; and chrysalid, plural chrysalids.

The Cocoon.—Many larvæ, as those of moths when fully grown and before they change to pupæ, spin about the body a silken case within which the transformations are undergone. This case is termed a cocoon. Frequently these cocoons are made within a rolled leaf (Fig. 11), or on the surface of the ground, where they are covered with dry grass or other rubbish. Certain hairy caterpillars make their cocoons largely of their hair, which they fasten together by a thin film of silk.

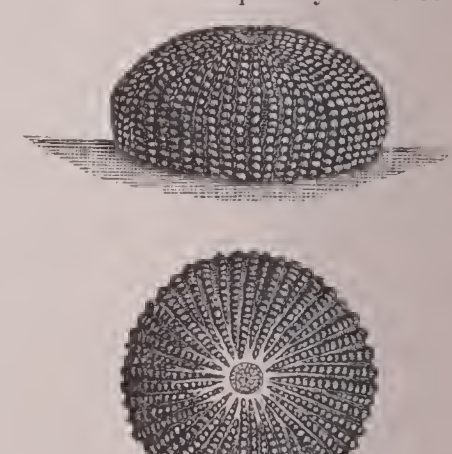


Fig. 10.—Egg of moth greatly enlarged.

Immature Forms of Insects with Incomplete Metamorphosis — The Nymph.—The terms larva and pupa are applicable only to the early stages of insects with a complete metamorphosis. In the case of those in which the transformation is an incomplete one the changes through which the immature insect passes after leaving the egg are so gradual that one can not indicate any point at which the insect ceases to be a larva and becomes a pupa. Recent writers have therefore used the term nymph (which was formerly used as a synonym of pupa) to designate the immature forms of insects with an incomplete metamorphosis. This term is applied to all the stages between the egg and the fully winged or adult state.

A nymph when it leaves the egg has no indications of wings. After undergoing a greater or less number of molts, differing in different species, small prolongations appear projecting from the dorsal aspect of the meso- and metathorax. These become larger and larger with each successive molt, assuming the form of pad-like wing-cases. But these wing-cases never approximate in length the perfect wings of insects in which these organs become fully developed. Consequently, there is usually a very marked change between the last nymph stage and the mature insect. This is illustrated by Figs. 12 and 13.

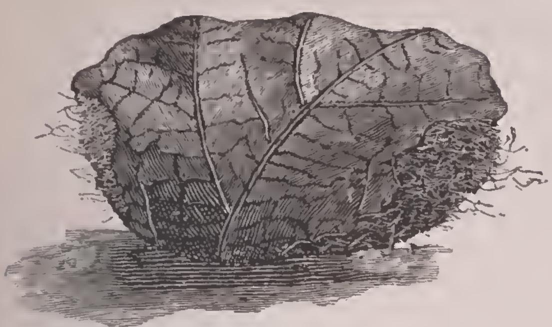


FIG. 11.—Cocoon made within a rolled leaf.

III. THE CLASSIFICATION OF INSECTS.—The term insect (from Lat. *in*, in + *sectus*, perf. ptc. of *seca're*, cut) refers to the fact that in the animals indicated by it the body is divided by transverse incisions into a series of segments. This insected form of the body is characteristic of the entire branch *Arthropoda* and of the worms as well, but the term insect has become restricted to a portion of this great series of animals. There is, however, a lack of uniformity in the use of the term among zoölogical writers. By some it is applied to all *Arthropoda* that breathe by means of a system of air-tubes (tracheæ) extending through the body. This includes centipedes, millipedes, spiders, and allied forms as well as six-footed insects. Other writers include among insects only those orders that are characterized by the possession of but six legs. It is in this restricted sense that the term insect has been used in this article; as thus restricted insects constitute the class *Hexapoda*.

FIG. 12.—Nymph of red-legged locust, last nymph stage.

Class *Hexapoda*.—This class includes those air-breathing *Arthropoda* in which the segments of the body are grouped into three regions—head, thorax, and abdomen. In the adult state the body is furnished with six legs and usually with wings. The class *Hexapoda* includes several orders, but entomologists are not agreed as to their number and limits. According to the classification that has been generally accepted till recently there are seven. But there are certain places in which this classification brings together insects which differ too widely to be classed in the same order; so that most of the leading entomologists advocate a considerable increase in the number of orders to be recognized. In the following list of the orders of the *Hexapoda* the names of the orders according to the old classification are given in the first column and the names of those adopted in this article in the second column.

FIG. 13.—Adult red-legged locust.

LIST OF ORDERS OF HEXAPODA.

NEUROPTERA.	1. Thysanura.
	2. Ephemerida.
	3. Odonata.
	4. Plecoptera.
	5. Isoptera.
	6. Corrodentia.
	7. Mallophaga.
	12. Neuroptera.
	13. Mecoptera.
	14. Trichoptera.
ORTHOPTERA.	8. Euplexoptera.
	9. Orthoptera.
HEMIPTERA.	10. Physopoda.
	11. Hemiptera.
LEPIDOPTERA.	15. Lepidoptera.
DIPTERA.	16. Diptera.
	17. Siphonaptera.
COLEOPTERA.	18. Coleoptera.
HYMENOPTERA.	19. Hymenoptera.

In the linear arrangement of the orders adopted in this article those orders are placed first which include insects having an incomplete metamorphosis, and second, those having a complete metamorphosis. By this arrangement three of the modern orders into which the Linnæan order *Neuroptera* (which was long the stumbling-block of all systems, inasmuch as its members combined the characters of most of the other orders) is divided are widely separated from the others, as indicated by the numbers in the second column in the table given above. Below is a brief tabular statement of the more important characters of the orders. This table will aid the reader in formulating the relation of the orders to each other, and will be of service in the classification of specimens.

TABULAR STATEMENT OF THE MORE IMPORTANT CHARACTERS OF THE ORDERS OF HEXAPODA.

A. Wingless insects which show no evidences of having descended from winged ancestors (i. e. in which the thorax is simple in structure), and which undergo no metamorphosis. 1. *Thysanura*.

AA. Winged insects, or wingless insects in which this condition is the result of a retrograde development, indicated by the complicated structure of the thorax, or by the presence of wings in closely allied forms.

B. Insects with an incomplete metamorphosis.

C. Mouth-parts formed for biting, i. e. with the mandibles and maxillæ in the form of jaws, or rudimentary.

D. The two pairs of wings similar in structure, membranous.

E. Not animal parasites.

F. Hind wings smaller than fore wings.

G. Wings with many veins and cross-veins. Mouth-parts rudimentary. 2. *Ephemerida*.

GG. Wings with comparatively few cross-veins. Mouth-parts formed for biting. 6. *Corrodentia*.

FF. Hind wings as large as or larger than fore wings.

G. Each wing with a joint-like structure, the *nodus*, near the middle of the front margin. 3. *Odonata*.

GG. Wings without nodus.

H. Hind wings much larger than the fore wings. Solitary insects. 4. *Plecoptera*.

HH. The two pairs of wings similar in form. Social insects. 5. *Isoptera*.

EE. Parasites of birds or mammals. 7. *Mallophaga*.

DD. The first pair of wings very short, leathery, without veins. Hind wings folded both longitudinally and transversely. Caudal end of abdomen with forcep-like appendages. 8. *Euplexoptera*.

DDD. The first pair of wings parchment-like; the second pair membranous and folded in plaits longitudinally. 9. *Orthoptera*.

CC. Mouth-parts intermediate in structure between those of the biting insects and those of the sucking insects; viz., with bristle-like mandibles and with flat, triangular maxillæ. 10. *Physopoda*.

CCC. Mouth-parts formed for sucking; viz., with the mandibles and maxillæ bristle-like. 11. *Hemiptera*.

BB. Insects with a complete metamorphosis.

C. Mouth-parts formed for biting; viz., both mandibles and maxillæ in the form of jaws, or rudimentary.

D. The two pairs of wings similar in structure, membranous, with many veins and cells.

E. Head prolonged into a beak. 13. *Mecoptera*.

EE. Head not prolonged into a beak.

F. Wings with numerous veins and with many cross-veins (except in a few rare forms, in which the wings are strengthened with a covering of whitish powder). 12. *Neuroptera*.

FF. Wings with numerous veins, but with only a few cross-veins. Wings more or less densely clothed with hairs. Insects moth-like. 14. *Trichoptera*.

DD. First pair of wings much thickened (horny) throughout their entire length, and meeting in a straight line down the back; the second pair membranous. 18. *Coleoptera*.

CC. Mouth-parts formed for both biting and sucking; viz., with the mandibles in the form of jaws, and with the maxillæ and labium fitted for taking liquid food. Both pairs of wings membranous, with few veins and cells. 19. *Hymenoptera*.

CCC. Mouth-parts formed for sucking.

D. With four wings clothed with minute imbricated scales; mandibles rudimentary; maxillæ developed into a sucking tube. 15. *Lepidoptera*.

DD. With only two wings; the hind wings represented by a pair of knobbed, thread-like organs; mandibles and maxillæ bristle-like. 16. *Diptera*.

DDD. Wingless parasites of animals (fleas). 17. *Siphonaptera*.

1. Order *Thysanura* (from Gr. ϑύσανος, fringe + οὐρά, tail).—The *Thysanura* includes the insects commonly known as bristle-tails, spring-tails, and fish-moths. These are wingless insects which undergo no metamorphosis, the larval form being retained by the adult. The mandibles and maxillæ are retracted within the cavity of the head, so that only their apices are visible; they have, however, some freedom of motion, and can be used for biting and chewing soft substances. True compound eyes are rarely present; but in some genera there is a group of agglomerated simple eyes on each side of the head. The abdomen is sometimes furnished with rudimentary legs, and in one genus there are well-developed abdominal legs.

Fig. 14.—*Lepisma saccharina*, a bristle-tail.

The absence of wings in this order is believed to represent the primitive condition of these insects. None of the species show any indication of the development of these organs, and the thorax does not present that complication of structure which is the result of the development of wing-muscles. In each of the higher orders we find wingless species; but in these cases there is good reason for believing that the wingless condition is the result of a retrograde development. In some cases this degradation is the result of parasitic habits, as with lice, fleas, and many other parasites; in other instances it is the result of the separation of the species into several castes, of which some do not require wings, as the workers and soldiers among Termes, the workers among ants, and the sedentary generations of the Aphides.

Fig. 15.—*Papirius fuscus*, a spring-tail.

This order comprises chiefly minute insects, which live on decaying vegetable matter, and can be found abundant in damp situations; some species, however, live in warm and dry places, and feed upon starched clothing and the binding of books and other dry substances. In the more common species the body is either elongated and furnished with six well-developed legs and two or more long, many-jointed caudal appendages (Fig. 14), or short, thick, and with a forked springing apparatus, bent under the abdomen, instead of the thread-like caudal appendages (Fig. 15).

The fish-moth, or silver-fish as it is sometimes called, *Lepisma saccharina* (Fig. 14), is a well-known pest in some parts of the U. S. It is silvery white, with a yellowish tinge about the abdomen and legs; it measures about one-third of an inch in length. It injures clothing, especially starched clothes, and the bindings of books. Sometimes it feeds upon the starch with which wall-paper is fastened in place.

2. Order *Ephemerida* (from Gr. ἐφήμερος, living but a day).—The order *Ephemerida* is composed of the insects commonly known as May-flies (Fig. 16). They have delicate, membranous wings furnished with a fine network of veins; the fore wings are large, and the hind wings are much smaller or wanting. The mouth-parts are rudimentary. The metamorphosis is complete. This order includes only a single family, the *Ephemeridæ*. The May-flies or Ephemerids are often very common insects in the vicinity of streams, ponds, and lakes; frequently the surface of such bodies of water is thickly strewn with them. They are attracted by light, and it is not an uncommon occurrence in summer-time to see hundreds of them flying about a street-lamp. The May-flies have received considerable attention in popular writings on account of their ephemeral existence in the adult state. All have read of the insects that live but a day. Reference is made in these accounts to members of this family; and although the popular idea is fallacious, it has some foundation in fact. Strictly speaking, the May-flies are long-lived insects; some species appear twice annually, once in the spring and again in the autumn; but, as a rule, one, two, or even three years are required for the development of a generation. The greater part of this time is passed, however, beneath the surface of the water, and after the insect emerges into the air and assumes the adult form its existence is very brief. With many species the individuals leave the water, undergo two transformations, mate, lay their eggs, and die in the course of an evening or within the early morning hours.

Fig. 16.—A May-fly.

With many species of May-flies there is great uniformity in the date of maturing of the individuals. Thus immense swarms of them will leave the water at about the same time, and in the course of a few days pass away, this being the only appearance of the species until another generation has been developed. The great swarms of "lake-flies" (*Ephemera simulans*) which appear along the lakes to the north of the U. S. about the third week in July afford good illustrations of this peculiarity.

3. Order *Odonata* (from Gr. ὀδούς, ὀδόντος, tooth).—The members of this order have four membranous wings, which are finely netted with veins; and each wing has near the middle of the front margin a joint-like structure, the nodus. The mouth-parts are furnished for biting. The metamorphosis is incomplete. The members of this order are commonly known as dragon-flies, darning-needles, spindles, and snake-doctors (Fig. 17). The eggs are laid in the water. In some species the female flies back and forth over the surface of the water, sweeping down at intervals to touch it with the tip of her abdomen, and thus wash off one or more eggs into it. In other cases the eggs are laid in a mass, attached to some aquatic plant. The nymphs of dragon-flies pass their lives in water. They are predaceous, feeding on such aquatic animals as they can overcome. When the nymph of a dragon-fly is fully grown it leaves the water to transform. The skin of the nymph splits open on the back of the thorax and head, and the adult emerges, leaving the empty skin of the nymph clinging to the object on which the transformation took place.

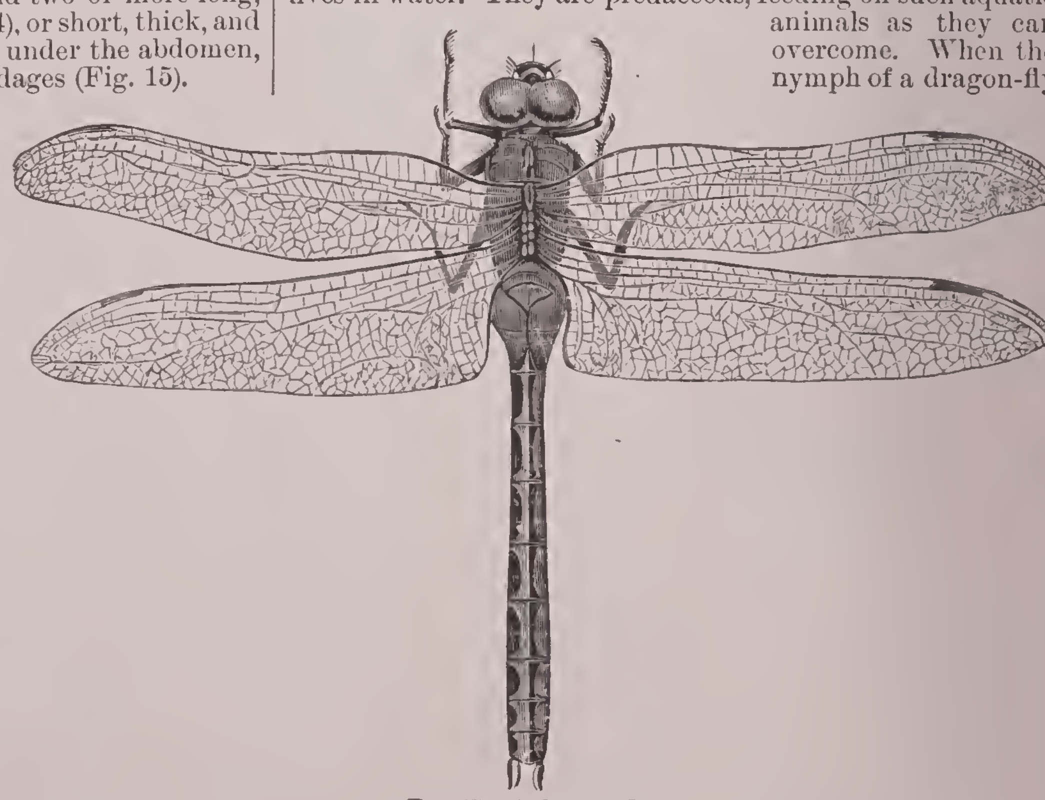


Fig. 17.—A dragon-fly.

Fig. 9 represents such a skin clinging to a water plant. The dragon-flies are predaceous in the adult as well as the nymph state, hence their vigorous flight and strong jaws render them formidable foes of less powerful insects. It is believed that they destroy many mosquitoes.

It is not strange that there should be popular superstitions regarding insects so conspicuous as these. It is a common belief among children that they have the power of sewing up the ears of people, hence the name darning-needle; while the Negroes in the Southern U. S. believe that dragon-flies hover over dead snakes, bringing them to life, and consequently call them snake-doctors.

4. Order *Plecoptera* (from Gr. πλέκειν, plait + πτερόν, wing).—The members of this order have four membranous wings, with comparatively few or with many cross-veins; the hind wings are much larger than the fore wings, and are folded in plaits and lie upon the abdomen when at rest. The mouth-parts are of the biting type of structure, but are often poorly developed. The metamorphosis is incomplete. This order includes a single family, the *Perlidæ*, or stone-flies (Fig. 18), including comparatively few species; but members of it are common about any of the creeks in the U. S. These insects are called stone-flies because the immature forms are very abundant under stones in the bed of streams. The adults are found flying about or resting upon herbage in the vicinity of water.

Fig. 18.—*Pteronarcys regalis*, a stone-fly.

It is easy to obtain the nymphs of these insects; by lifting stones from the water of swiftly flowing streams the young stone-flies may be found closely adhering to their lower surface. They present a wonderfully flattened appearance (Fig. 19); the body is depressed and closely applied to the stone; while the legs, antennæ, and caudal setæ radiate from it on the surface of the stone. In the common forms there is a tuft of hair-like tracheal gills just behind the base of each leg, and the more mature individuals present conspicuous wing-pads. The nymphs of stone-flies constitute an important element in the food of fishes, and probably are found more often than any other insect in the stomachs of brook trout. When about to transform to the adult state, the insect crawls from the water upon a stone or some other object. Their exuviæ are common in these situations.

Fig. 19.—Nymph of a stone-fly, *Acroneura*.

5. Order *Isoptera* (from Gr. ἴσος, equal + πτερόν, wing).—This order comprises the Termites, or white ants, social insects in which each species consists of several distinct castes, of which only the "kings" and the "queens" are winged. These have four long narrow wings which are somewhat leathery in structure, and which are furnished with numerous but more or less indistinct veins. The two pairs of wings are similar in form and structure, and are laid flat upon the back when not in use. The mouth-parts are formed for biting. The metamorphosis is incomplete. The order includes only a single family, the *Termitidæ*.

These insects can be easily recognized by the pale color of the greater number of individuals of which a colony is composed, by the fact of their living in large ant-like colonies, and by the form of the abdomen, which is broadly joined to the thorax instead of being pedunculate as in the ants.

The Termites are commonly called white ants on account of their color and of a resemblance in form and habits to true ants. These resemblances, however, are only very general. In structure the Termites and ants are widely separated, as the former are among the lowest of winged insects, while the latter stand near the head of the series. In habits there is little more in common than that both are social, and the fact that in each the function of reproduction is restricted to a few individuals; while the greater number differ in form from the sexually mature males and females, and are especially adapted to the performance of the labors of the community. There are always at least three distinct castes, each represented by both sexes—the workers, the soldiers, and the sexual forms. Sometimes when the true sexual forms are lacking, a fourth caste, the complemental males and females, are developed as a substitute. The true sexual forms alone are winged. As each of the four castes is represented by both sexes, a single species of Termites may be represented by eight forms of individuals.

Fig. 20.—*Termes flavipes*, worker.

The form of the *worker* is represented by Fig. 20. The members of this caste may be looked upon as individuals whose physical, and especially sexual, development has been checked while yet nymphæ and never carried further. But the development of their instinctive powers is truly remarkable; for it is this caste that builds the nests, collects the provisions, and cares for the young. Associated with the workers, and resembling them in color and in being wingless, there occur numerous representatives of another caste, which can be recognized by the enormous size of their heads (Fig. 21). These are the *soldiers*, upon whom devolves the protection of the colony. They are well adapted for this work, their powerfully developed mandibles rendering them formidable. In some species the male and female soldiers differ externally, so that they can be distinguished without dissection. But here, as with the workers, the reproductive organs are rudimentary.

Fig. 21.—*Termes flavipes*, soldier.

The sexually perfect *males* and *females* are developed in large numbers at a certain season of the year, late spring or early summer for the species common in the U. S. In May or June these winged males and females leave the nest in a body. Sometimes clouds of them appear. After flying a greater or less distance they alight on the ground and then shed their wings. At this time the males seek the females, seizing them with their mandibles; but it is believed that pairing does not take place till a later period. The greater number of individuals composing one of these swarms soon perish. But in a few cases a couple is taken in charge by some workers, and thus is founded a new colony. There is usually at the head of the colony only a single pair of sexual individuals. These have been termed the king and queen. A cell is provided by the worker Termites for them, shaped like an inverted watch-glass, and is furnished at first with a single small opening; later there are several. Within this cell the royal pair remain prisoners, but they are carefully attended by numerous workers. As the eggs develop in the body of the female her abdomen becomes greatly extended. Fig. 22 represents such a queen, natural size. The dark spots along the middle of the dorsal wall of the abdomen are the chitinized parts of that region; the lighter portions are made up of the very much stretched membrane uniting the segments; along each side of the abdomen the spiracles are visible. The specimen figured is a comparatively small one; in some species the queen becomes 6 or 8 inches in length.

Fig. 22.—Queen white-ant, *Termes gilvus*.

In addition to the winged males and females just described, there are sometimes developed wingless sexual individuals which never leave the nest. These are termed *complemental males* and *females*, and they serve as substitutes for the winged males and females whenever a community does not find a true king or queen. The complemental females produce comparatively few eggs, and consequently never become as large as do the true queens. It requires several of these to replace a queen. Fritz Müller found in one case a king living in company with thirty-one complemental females. As these wingless males and females never leave the nest, they pair with their near relatives. The development of winged sexual forms is therefore necessary in order to provide for intercrossing of individuals not closely related. Doubtless here, as with the true ants, the winged males and females emerge from many nests at the same time and mingle in a single swarm; in this way there is opportunity for intercrossing.

There is space here for but little regarding the habits of these wonderful insects. In the tropics certain species build nests of great size. Some of these are mounds 10 or 12 feet in height. Other species build large globular masses upon the trunks or branches of trees. All of the Termites are miners, and all avoid the light. They therefore build covered ways from their nests to such places as they wish to visit. In some hot countries they are the worst of all pests. They will feed upon almost any organic matter; they destroy wooden structures of all kinds, including buildings and furniture. Libraries are often completely ruined by them. In infesting anything composed of wood they usually eat out the interior, leaving a thin film on the outside. Thus a table may appear to be sound, but will crumble to pieces beneath a slight weight, entrance having been made through the floor of the house and the legs of the table.

The mounds of Termites are composed chiefly of the excreted undigested wood upon which the insects have fed. This is molded into the desired form, and on drying it becomes solid. The species that occur in the U. S. do not build mounds, but make their nest in the ground and in logs, stumps, and other wood.

6. Order *Corrodentia* (from Lat. *corrodere*, gnaw).—The winged members of this order have four membranous wings, with the veins prominent and with comparatively few cross-veins; the fore wings are larger than the hind wings, and both pairs when not in use are placed roof-like over the body, being almost vertical and not folded in plates. The mouth-parts are formed for biting. The metamorphosis is incomplete. The best-known representatives of this order are the minute insects found in old books—the book-lice. These wingless creatures form, however, but a small part of the order. The more typical forms (Fig. 23) bear a strong resemblance to plant-lice (*Aphides*), and occur upon the leaves and trunks of trees and on stone walls and palings. They feed upon lichens and probably upon other dry vegetable matter, and are frequently gregarious, occurring in communities of 100 or more closely huddled together.

Fig. 23.—*Psocus venosus.*

7. Order *Mallophaga* (from Gr. μαλλός, lock of wool + φαγεῖν, eat).—The members of this order are wingless parasitic insects, with biting mouth-parts. Their metamorphosis is incomplete. Although some species infest sheep and goats, feeding upon their wool, by far the greater number live among the feathers of birds; consequently, the name bird-lice is applied to the entire order. Fig. 24 represents a species which infests the horse. The bird-lice resemble the true lice in form, being wingless, and with the body more or less flattened, but differ in having biting mouth-parts. Certain species which infest domestic fowls are well-known examples. They feed upon feathers, hair, and dermal scales, while the true lice (family *Pediculidæ*, order *Hemiptera*) have sucking mouth-parts, feed upon blood, and infest only mammals. *Menopon pallidum* is one of the species which infest the hen. It is to free themselves from this and allied parasites that hens wallow in dust and scatter it among their feathers.

Fig. 24.—*Trichodectes æqui*, a bird-louse.

8. Order *Euplexoptera* (from Gr. εὖ, well + πλέκειν, fold + πτερόν, wing).—This order includes only the earwigs (family *Forficulidæ*). With these insects the first pair of wings are leathery, very small, without veins, and when at rest meet in a straight line down the back, partially covering the second pair of wings (Fig. 25). These wing-covers strongly resemble those of the rove-beetles. The second pair of wings (Fig. 26) are furnished with radiating veins which extend from a point near the end of the basal third of the wing over the distal part of this organ. When the wing is not in use this part is folded in plaits like a fan, and the wing is folded twice transversely. The most striking character of this family is the form of the cerci, which are horny, and resemble forceps.

Fig. 25.—An earwig.

The earwigs are rare in the U. S., especially in the North. But in Europe they are common, and are often troublesome pests. They are nocturnal, hiding in the daytime among leaves and in all kinds of crevices, and coming out by night. They feed upon the corollas or flowers, fruit, and other vegetable substances. When troublesome they may be trapped with hollow objects, into which they can crawl and hide during the daytime. The name of the typical genus, *Forficula*, is the Latin word for scissors. It was suggested by the curious form of the cerci. The common name, earwig, has reference to a widely spread fancy that these insects creep into the ears of sleeping persons.

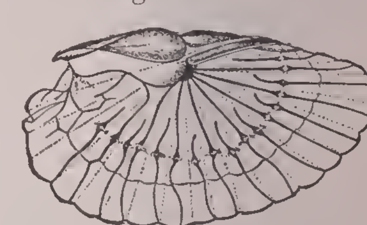


Fig. 26.—Wing of an earwig.

9. Order *Orthoptera* (from Gr. ὀρθός, straight + πτερόν, wing).—The members of this order have four wings; the first pair are thickened, and overlap when at rest; the second pair are thinner, and are folded in plaits like a fan. The mouth-parts are formed for biting. The metamorphosis is incomplete. This order includes the cockroaches, locusts or grasshoppers, katydids, crickets, walking-sticks, and soothsayers or praying mantes. The most familiar examples are the locusts, commonly called grasshoppers in the U. S. (Fig. 27). They abound everywhere, and occasionally

Fig. 27.—The crested locust.

multiply to such an extent as to cause serious injury to vegetation. Scarcely less abundant are the crickets. Their chirping is a sexual call produced by the males by rubbing together the wing-covers, as the first pair of wings are termed in these insects. Upon each of the wing-covers there is a strong cross-vein furnished with ridges like a file, and on the inner edge of the wing-cover there is a hardened portion, the scraper. In chirping the cricket elevates its wing-covers, and rubs the file of one against the scraper of the other. In this way the wing-cover is thrown into rapid vibration and the chirp is produced. The cry of the katydid is produced in a similar manner.

The *Orthoptera* as a whole are injurious to vegetation; but the soothsayers or praying mantes are predaceous.

10. Order *Physopoda* (from Gr. φυσᾶν, blow up + πούς, ποδός, foot).—This order includes the insects commonly known as thrips (Fig. 28). These are insects of minute size, rarely exceeding one-eighth of an inch in length, and usually much smaller. They abound in various flowers, especially those of the daisy and clover. Ordinarily it is only necessary to pull apart one of these flowers to find several of these insects. Their most striking character and the one which suggested the name of the order is the form of the tarsi. These are bladder-like at the tip, and without claws. The two pairs of wings are similar in form. Each wing is long, narrow, membranous, not folded, with but few or no veins, rarely with cross-veins, fringed with long hairs, and laid horizontally along the back when at rest. The mouth-parts are probably used chiefly for sucking; they are intermediate in form between those of the sucking and those of the biting insects. The metamorphosis is incomplete.


Fig. 28.—A thrips, greatly enlarged.

11. Order *Hemiptera* (from Gr. ἡμι, half + πτερόν, wing).—The winged members of this order have four wings; in one suborder the first pair of wings are thickened at the base, with thinner extremities which overlap on the back; in another sub-order the first pair of wings are of the same thickness throughout, and usually slope at the side of the body. The mouth-parts are formed for sucking. The metamorphosis is incomplete.

This order includes three well-marked groups, which are ranked as sub-orders. The first of these, the *Heteroptera*, includes the true bugs. In this sub-order the first pair of wings are thickened at the base, while the tips, which overlap each other on the back of the insect, are thin and transparent. The most familiar examples are the well-known stink-bugs (Fig. 29). Here belong also the squash-bug, the chinch-bug, and many other well-known pests of the agriculturists. The second sub-order, the *Parasita*, includes certain parasites of man and other mammals, commonly known as lice. They are wingless, and differ from other *Hemiptera* in having the beak fleshy and not jointed. Fig. 30 represents a common species, *Hæmatopinus eurysternus*, which infests the cow. Three species infest man: the head-louse, *Pediculus capitis*; the body-louse, *Pediculus vestimenti*: and the crab-louse, *Phthirius pubis*. It will be remembered that the true lice differ from the bird-lice, order *Mallophaga*, in having sucking mouth-parts. The true lice live on the skin of mammals and suck their blood. The third sub-order, the *Homoptera*, includes insects of widely diversified forms, which agree, however, in having the wings when present of the same thickness throughout, and usually sloping roof-like at the sides of the body when at rest. This sub-order includes the cicadas, the aphids, the scale-bugs, and many other common forms. The largest representatives that are natives of the U. S. are the cicadas (Fig. 31). These are well known on account of the shrill cry of the male; and one species, the periodical cicada (improperly termed the seventeen-year locust), attracts much attention on account of the great numbers in which it appears. Among the more important enemies of fruit-trees are the aphids and the scale-bugs.


Fig. 29.—A bug.


Fig. 30.—Louse of cow.


Fig. 31.—*Cicada tibicen.*

12. Order *Neuroptera* (from Gr. νεῦρον, nerve + πτερόν, wing). — The members of this order have four wings; these are membranous and furnished with many veins, and usually with many cross-veins. The head is not prolonged into a beak. The mouth-parts are formed for biting. The metamorphosis is complete. The order *Neuroptera* as now restricted is represented in the U. S. by only two families. To one of these the well-known Hellgrammite-fly, *Corydalis cornuta* (Fig. 32), belongs; the other includes the aphis-lions and the ant-lions.


Fig. 32.—*Corydalis cornuta.*

13. Order *Mecoptera* (from Gr. μῆκος, length + πτερόν, wing). — The members of this order have four wings; these are membranous and furnished with numerous veins. The head is prolonged into a beak, at the end of which biting mouth-parts are situated. The metamorphosis is complete. The most common members of this order are the scorpion-flies, *Panorpa* (Fig. 33), so called on account of the peculiar form of the caudal part of the abdomen of the male, which at first sight suggests the corresponding part of a scorpion.

14. Order *Trichoptera* (from Gr. θρίξ, τριχός, a hair + πτερόν, wing).—This order includes the caddice-flies, which are moth-like insects in appearance. They have four wings, which are membranous, furnished with numerous veins, but with only few cross-veins, and more or less densely clothed with hair. These insects are most likely to attract attention in the larval stage, owing to the curious habit the larvæ have of building tube-like cases in which they live. Fig. 34 represents a common species in its case. These larvæ live in water, and the various species make cases of different forms.


Fig. 33.—*Panorpa.*

15. Order *Lepidoptera* (from Gr. λεπίς, -ίδος, a scale + πτερόν, wing).—This order includes the moths and the butterflies. These insects have four membranous wings which are covered with overlapping scales. The mouth-parts are formed for sucking. The metamorphosis is complete. Moths and butterflies are readily distinguished by their well-known form and by the clothing of scales with which the body and wings are covered. These scales are modified hairs, and every gradation in form from that of a hair to a short broad scale can be found on a single insect. In the more primitive moths the scales are scattered irregularly over the wings; but in the more specialized forms the scales are arranged with great regularity in overlapping rows. The larvæ of the *Lepidoptera* are caterpillars, and as a rule are injurious to vegetation. Among the more important species are the codlin-moth (found in apples), the peach-tree

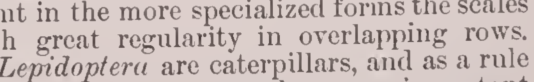


Fig. 34.—Caddice-worm and case.

borer, the army-worm, the cabbage-worm, the cotton-worm, and the boll-worm. A few caterpillars feed upon scale-bugs, and must therefore be classed among beneficial insects. But the most important member of this order is the silk-worm (Fig. 35). The luna-moth (Fig. 8) is one of the most striking in appearance of the moths native in the U. S.

FIG. 35.—The silkworm in all its stages.

16. Order *Diptera* (from Gr. δι, δίς, twice + πτερόν, wing).—This order includes the flies, which differ from other insects in possessing only a single pair of wings. The second pair of wings is represented by a pair of knobbed threads, termed *halteres*. The mouth-parts are formed for sucking. The metamorphosis is complete. The larvæ of flies are maggots; they are usually cylindrical in form, and are footless. Most species transform within the dried skin of the larvæ; a few have naked pupæ, and some make a cocoon. The different species vary much in habits. Some are very annoying to man: as the mosquito which attacks his person; the flesh-flies which infest his food; the bot-flies and gad-flies which torment his cattle; and the gall-gnats which destroy his crops. Other species are very beneficial, as the various species that are parasitic upon other insects, as well as many other species which feed upon decaying animal and vegetable matter, thus acting as scavengers. Fig. 36 represents a species which is parasitic upon the army-worm. In the lower part of the figure is represented the fore part of an army-worm bearing eggs of the fly; the larva is shown on the left, the pupa on the right, and the adult in the middle.

FIG. 36.—*Nemoræa leucaniæ*, a dipterous parasite of the army-worm.

17. Order *Siphonaptera* (from Gr. σίφων, tube + ἄπτερος, wingless).—This order includes the fleas, and the famous jigger of tropical America. In these insects the three segments of the thorax are distinct and nearly equal. The mesothorax and metathorax bear short leaf-like appendages in the place of wings. The mouth-parts are formed for sucking. The metamorphosis is complete. The larvæ are worm-like in form, being long and slender. They can be found in the sleeping-places of cats and other animals. When full grown they spin a silken cocoon within which the pupa state is passed. The body of the adult is much compressed, admitting of free movement among the hairs of the host, and the legs are fitted for leaping.

18. Order *Coleoptera* (from Gr. κολεός, sheath + πτερόν, wing).—The members of this order have four wings, the first pair of which are termed *elytra*, and are much thickened, meeting in a straight line down the back; the second pair are membranous, and when not in use are folded beneath the elytra. The mouth-parts are formed for biting. The metamorphosis is complete. This order includes only the beetles, which can be distinguished from all other insects, except the earwigs, by the peculiar form of the fore wings or elytra; they differ from the earwigs in lacking the caudal forceps characteristic of those insects. The larvæ of beetles are commonly called grubs. They are usually furnished with six thoracic legs, and often with a single proleg at the caudal end of the body. The pupæ have the partially developed legs and wings folded upon the breast, but in distinct sheaths. These insects usually transform in rude cocoons made of earth or bits of wood fastened together by a viscid substance excreted by the larva. Both beetles and their larvæ vary greatly in habits. Many species are predaceous, and are thus beneficial to man by destroying insect pests; but others feed upon vegetable matter, and are thus noxious. Among the important pests are many species of borers infesting trees. Other species feed upon the foliage of plants, as the Colorado beetle. Fig. 37 will serve to illustrate the form of the members of this order.

19. Order *Hymenoptera* (from Gr. ὑμήν, membrane + πτερόν, wing).—The members of this order have four wings; these are membranous, and furnished with comparatively few or with no transverse veins. The second pair of wings is smaller than the first. The mouth-parts are formed both for sucking and biting. The abdomen of the female is usually furnished with a sting, piercer, or saw. The metamorphosis is complete. The members of this order are well known to every observer. They are among the first of insects to attract attention, abounding wherever flowers bloom; and the habits of certain forms, as the ants, bees, and wasps, have excited wonder and admiration from the earliest time. Fig. 1 represents a member of this order.

The larvæ of *Hymenoptera* are usually footless, maggot-like creatures, incapable of any extended motion, and entirely dependent on the provision made for them by the adult insects. But in the two lower families, the saw-flies and the horn-tails, the larvæ are furnished with legs, and frequently have a striking resemblance to caterpillars both in form and habits. As a rule, the larvæ of saw-flies (*Tenthredinidæ*) feed upon the foliage of plants, and the larvæ of the horn-tails (*Siricidæ*) bore in the more solid parts. The gall-flies (*Cynipidæ*) also feed upon vegetable matter; but their method of attack is peculiar. The gall-fly lays her egg within the tissue of the plant; when the egg hatches the young larva begins to feed upon the plant, and immediately there takes place an abnormal growth of the plant about the larva. The larva is thus inclosed in what is known as a gall. Galls are familiar objects, especially upon oaks.

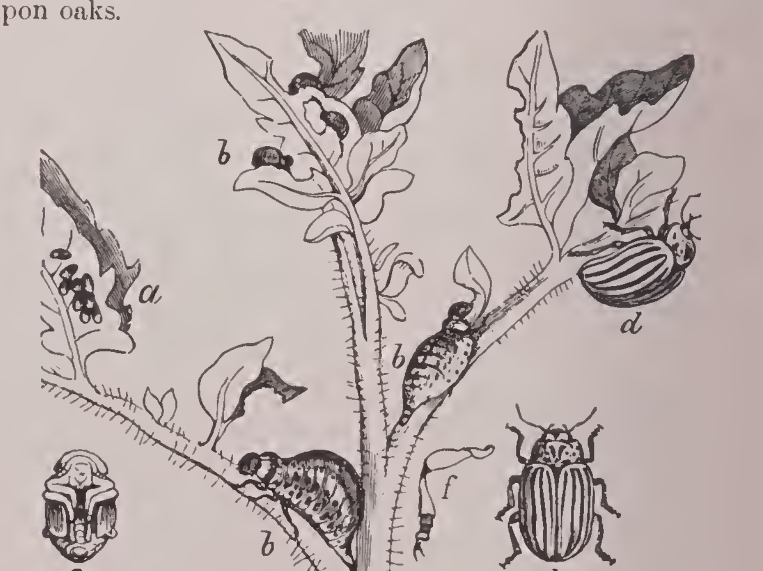


FIG. 37.—Colorado potato-beetle: *a*, eggs; *b*, *b*, *b*, larvæ; *c*, pupa; *d*, *d*, beetle from side and back. Colors, *a*, orange; *b*, Venetian red; *c*, pale orange; *d*, black and yellow.

Several families of this order are parasites. The eggs are laid either in or upon the bodies of other insects; and the larvæ obtain their growth within the body of the host. These parasitic *Hymenoptera* play an important part in preventing the undue increase of insects injurious to vegetation.

In the higher families of the order is found the most remarkable development of instinctive powers known. Many volumes have been written on the habits of the bees, wasps, ants, and digger-wasps. Among the bees, wasps, and ants, we find social insects. Here each species consists of three castes—males, females, and workers. The workers are females in which the reproductive organs are usually imperfectly developed, although occasionally they are fertile.

Bibliography.—The literature of entomology is very extensive. Insects are discussed not only in the books and journals treating of general zoölogy, but there is also an immense number of special entomological works. As an illustration it can be stated that there are being published regularly at least thirty important journals devoted exclusively to this subject, and this number does not include the minor journals and those merely of local interest. The more important are the following: *The Transactions of the American Entomological Society* (Philadelphia); *Insect Life* (Washington); *Entomological News* (Philadelphia); *Psyche* (Cambridge, Mass.); *Canadian Entomologist* (London, Ontario); *Transactions of the Entomological Society of London* (London, England); *The Entomologist* (London); *Entomologists' Monthly Magazine* (London); *Annales de la Société Entomologique* (Paris); *Bulletin d'Insectologie Agricole* (Paris); *Berliner Entomologische Zeitschrift* (Berlin); *Deutsche Entomologische Zeitschrift* (Berlin); *Wiener Entomologische Zeitung* (Vienna); *Entomologische Zeitung* (Stettin); *Mittheilungen der Entomologischen Gesellschaft* (Schaffhausen); *Tijdschrift voor Entomologie* (The Hague); *Entomologisk Tidskrift* (Stockholm).

The following are important works of reference: Hagen, *Bibliotheca Entomologica*, which gives the titles of all works on entomology published before 1862; Taschenberg, *Bibliotheca Zoölogica II.*, which includes a catalogue of zoölogical papers published in periodicals during the years 1861–80; *Bericht über die wissenschaftlichen Leistungen im Gebiete der Entomologie*, an annual record of the progress of entomology, now forming one part of the *Deutsche Entomologische Zeitschrift*. The entomological portions of the *Zoölogical Record* and of the *Zoölogischer Jahresbericht* should also be consulted. *Bulletin No. 19* of the division of entomology of the U. S. Department of Agriculture consists of a classified list of the published synopses, catalogues, and lists of North American insects.

The principal general text-books treating of American insects are those of Packard and Comstock. *Insects Injurious to Vegetation*, by Harris, has done more than any other American book to stimulate a love for entomology, and although it is limited in its scope, as indicated by its title, it should be one of the first books in any entomological library. *Introduction to Entomology*, by Kirby and Spence, is the best popular work on the habits of insects. This is also a very old book and is out of print, but it can be found in almost any public library. John Henry Comstock.

Entomoph'aga [from Gr. ἔντομα (sc. ζῷα), insects + φαγεῖν, eat]: a term applied by different zoölogists to groups of very diverse insect-eating animals. The name was given by Owen in 1839 to a division of *Marsupialia* containing the bandicoots and opossums, by Huxley to a group of the *Edentata*, comprising the ant-eaters, pangolins, and aardvarks, and by Woodward to a division of *Hymenoptera*, including insectivorous or parasitic forms such as the ichneumons, *Chalcididæ*, and others. It is also used for the small insectivorous bats or *Microcheiroptera*, as distinguished from the large fruit-eating bats, the *Megacheiroptera* or *Frugivora*. F. A. Lucas.

Entomos'traca [from Gr. ἔντομος, cut in pieces + ὄστρακον, shell]: the lowest sub-class of Crustacea. The body consists of a variable number of segments, those of the hinder portion being frequently without appendages. There is always, at least in the young, a single median eye, and frequently paired eyes are present. Frequently there is developed a dorsal shield which may become folded into a bivalve shell. The number of appendages varies from eight to over sixty pairs. All pass through a metamorphosis, a nauplius larva (see Crustacea) escaping from the egg, and this usually transforms into a cyclops-like or a cypris-like form. Most of the species are small, and many become extremely modified by parasitism. (See Degeneration.) All are aquatic, and as they are enormously abundant they form a very important element in the food of fishes. They are divided into five orders, Phyllopoda, Cladocera, Ostracoda, Copepoda, and Cirripedia (*qq. v.*). J. S. Kingsley.

Entozo'a [from Gr. ἐντός, within + ζῷον, animal]: a name formerly used for various parasitic animals usually grouped together as worms, but which have no other bond of union than the fact that they live within the bodies of other animals. The important ones belong to the Vermes (true worms), the lowest form of articulate animals. They are divided into (1) cestoid worms, or tapeworms, which are all more or less jointed, of a ribbon-like form, each joint of hermaphrodite conformation, and dwelling in the intestines. The embryonic worms penetrate the tissues, become surrounded by a cyst, and are known as "cystic" worms. They have no alimentary canal. (2) The flukes or trematode worms, of flat, oval form, smooth, soft, and not jointed. They have an hermaphrodite development, the sexual organs pervading a great part of the body of the adult. They afford many wonderful examples of the so-called alternate generation and of parthenogenesis in some of the generations. The disease called rot in sheep is caused by their presence in the biliary passages. In man they cause the hæmaturia prevailing at the Cape of Good Hope and an endemic diarrhœa of Egypt. They inhabit the liver, kidneys, lungs, etc. Among the genera are *Distoma*, *Bilharzia*, and many others. When perfect they have an alimentary canal without vent. (3) The nematodes or round worms, having long, cylindroid forms, and in the more perfect forms an intestinal canal with mouth and vent, and distinct sexes. This class includes pinworms, *Ascarides*, the *Trichina*, the Guinea worm, and many others. Besides the Vermes there are innumerable lower forms infesting the alimentary tract. Of these, the *Amœba coli*, a form supposed to produce dysentery and certain other protozoa, the *Coccidia*, have been studied with great interest. See Cestoid Worms, Nematelmia, Nematoidea, Trematoda, Trichina, and Parasites.
Revised by William Pepper.

Entrecasteaux, Joseph Antoine Bruni, d', daañt'r'kaas'tō': navigator; b. at Aix, France, 1739; commanded a frigate in 1778, and distinguished himself by his successful protection of some merchant vessels against pirates; in 1785 he was placed in command of the East India fleet, and was afterward sent in search of La Pérouse. Though he failed in the object of this search, he made important discoveries. D. at sea near Java, July 20, 1793. His name is perpetuated in the d'Entrecasteaux Archipelago (*q. v.*), in d'Entrecasteaux Point on the southwestern coast of Western Australia, and in d'Entrecasteaux Channel between Tasmania and Bruni island.

Entre Douro e Minho: See Minho.

Entre Rios: a province of Argentina; occupying the southern portion of the peninsula between the rivers Paraná and Uruguay; bounded N. by Corrientes, E. by Uruguay, S. by Buenos Ayres, and W. by Santa Fé. Area, 45,000 sq. miles. The river Gualeguay flows southward through nearly the whole length of the province, and its watershed is divided from those of the Uruguay and Paraná by two ranges of low hills (called *cuchillas*) which unite toward the north. In the southern part there are extensive low swampy tracts near the Paraná and Uruguay. The whole country is well watered and fertile, forming one of the finest districts of the republic. Most of the land is open, but there are extensive forests in the north. The principal industry is grazing, immense herds of cattle and horses and flocks of sheep being raised on the great *estancias*; in connection with these are large meat-drying establishments, tanneries, etc. Wheat, maize, barley, flax, and tobacco are grown. The only mineral product of importance is lime. The Central Entreriano Railroad runs across the province from Paraná to Concepcion. Entre Rios formerly included all the region between the Paraná and Uruguay; Corrientes was separated in 1814. The progress of the province during the nineteenth century has been phenomenal. Pop. (1895) 290,994. The principal cities are Paraná, the capital, with 24,100 inhabitants; and Gualeguaychú, Gualeguay, Concordia, and Concepcion del Uruguay, each with more than 10,000. Herbert H. Smith.

Entry: the act of entering. In criminal law, in addition to breaking, entry is necessary to constitute the crime of burglary, but this need not be with the whole body. If any part of the person or of an instrument be introduced within the building with intent to commit a felony, it is sufficient; but if only the instrument intended to be used in the breaking enters, it is not enough to constitute the offense. See Burglary.

In the law of real estate, entry is the taking actual possession of land. By the common law a person had a right, when deprived of the possession of his land by a person whose original entry was unlawful, to regain his legal possession by a formal and peaceable act of entering upon it with the declaration that he thereby takes possession. When the disseizor's original entry was lawful the owner was driven to an action. The common-law action of *writ of entry* is now disused. Any going upon the land of another is often termed an entry, and unless done with the permission of the owner is in most instances unlawful and a trespass. Revised by F. STURGES ALLEN.

Environment: in zoölogy and botany, the sum of the conditions or surroundings of an animal or plant. Climate, the physical features of a country, absence or presence of enemies, and ease or difficulty of procuring food are among the more important factors of environment. F. A. L.

Envoy [*envoy* is from O. Fr. *envoye* (Mod. Fr. *envoi*), deriv. of *envoiier* (Mod. Fr. *envoyer*), send: Ital. *inviare*: Span. *inviar* < Lat. *in* + *via*, way]: a messenger; in political matters a person deputed by a ruler or government for transacting business with a foreign ruler or government. In diplomacy the term envoy extraordinary and minister plenipotentiary is applied to a diplomatic agent of rank next below an ambassador. See AMBASSADOR, DIPLOMATIC AGENTS, and INTERNATIONAL LAW.

Enzina, JUAN DEL: See ENCINA.

Enzio, or **Enzo**: soldier; natural son of the Emperor Frederick II. of Germany; b. 1225; fought at his father's side in the battle of Cortenuova at the age of thirteen; in the following year married Adelasia, the widow of Waldo Visconti and heiress of Sardinia and Corsica, and received the title of King of Sardinia. In 1239 he was made vicar imperial, with the task of subduing the Guelph cities of Northern Italy, and in spite of his youth became the ablest of Ghibelline leaders. The cities of Umbria were reduced to obedience, and the best military talent of his enemies was enlisted against him in vain. Toward the end of the year he was excommunicated by the pope. Taking command of the allied imperial and Pisan fleets, he defeated the Genoese in 1241 near the island of Meloria, sank three and captured nineteen of their vessels, and took 4,000 prisoners, including many prelates of high rank who were journeying to the Roman council. His next service to the emperor was his victory conjointly with his brother over the Tartars on the river Delphos. In 1247 he was again active in Northern Italy against the Guelphs, whose revolt, however, could not be suppressed, and though he captured Arola, where his murder of prisoners left a stain on his reputation, all but Modena and Reggio were lost to the emperor. Gathering his forces for a final effort, he met the Bolognese in battle on the banks of the Fossalta, but was defeated and taken prisoner. So great was the fear felt for him by his captors that the senate and people of Bologna decreed his perpetual confinement. Neither the offer of ransom nor the threats of punishment made by the emperor could procure the release of Enzio, who, however, was treated with honor, and experienced no hardship save the loss of his liberty. His captivity lasted twenty-three years. D. Mar. 14 or 15, 1272. F. M. COLBY.

E'ocene Period [*eocene* is from Gr. ἠώς, dawn + καινός, new]: the division of geologic time following the Cretaceous period and preceding the Neocene: the earlier part of the CENOZOIC (*q. v.*) or Tertiary era. Eocene life is distinguished from Cretaceous by the disappearance or subordination of archaic and the substitution of modern types. Among vertebrates domination passed from the reptiles to the mammals. The Ammonites and their aberrant congeners, as well as the Rudistes and Inocerami, became extinct, and were replaced by representatives of such familiar genera as *Ceritheum*, *Conus*, *Fusus*, *Voluta*, and *Cardium*. Arborescent ferns and cycads gradually disappeared, leaving the aspect of the forest essentially modern.

In the U. S. Eocene rocks occupy a broad belt parallel but not adjacent to the Gulf and Atlantic coasts, from Texas to North Carolina. In the Mississippi valley an extension of the belt reaches northward to the mouth of the Ohio, and there is another in Florida. A narrower belt crosses New Jersey, Delaware, Maryland, and Virginia. A few smaller areas are known in California, Oregon, and Washington, and extensive lacustrine beds of the same age occur in Wyoming, Utah, Colorado, and New Mexico. The strata include marls of agricultural value in the eastern district, phosphates in Florida, and coal in the interior. See GEOLOGY. G. K. G.

Eohip'pus [from Gr. ἠώς, dawn + ἵππος, horse]: an extinct genus of the horse family occurring in the Lower Eocene deposits of the West, and allied to *Orohippus* (see HORSE, FOSSIL), but of a less specialized form, and apparently in the direct ancestral line. The feet had four toes in front and three behind, with a rudiment of the outer or fifth metatarsal, and may have had a rudiment of the first toe in the fore foot. This genus is represented by species from the lowest Eocene beds of New Mexico and Wyoming.

Eolian Harp: See ÆOLIAN HARP.

Eon (or **Eudo**) **de Stella**: a fanatic of the twelfth century; an ignorant (and perhaps insane) nobleman of Bretagne, who, having heard, during the act of exorcism, the words "through Him" (*per Eum*, etc., in Latin) "who will come to judge the quick and dead," concluded, from the resemblance between his own name *Eon* and the Latin *Eum*, that he was the one appointed as the final judge of mankind. He taught a reformed doctrine, and gained many disciples. He was captured in 1148, and many of his followers (called Eonians) were burned, but Eon himself was pronounced insane, and seems to have been spared.

E'os [a personification of Ion. Gr. ἠώς, Attic Gr. ἕως, dawn; cf. Lat. *auro'ra*, Sanskr. *usha's-*]: in the Greek mythology, a daughter of Hyperion, a sister of Helios (the sun), and the wife of Tithonus. See AURORA.

Eosin: See PHTHALIC ACID.

Eötvös, or **Eoetvoes**, ā'öt-vösh, JOSEPH, Freiherr von: Hungarian author and statesman; b. in Buda, Sept. 13, 1813; educated at the University of Pesth. About the age of twenty he produced *Boszú*, a tragedy, and two successful comedies entitled *Kritikusok* and *Hazasulok*. He also gained distinction as a political writer and orator of the popular party. Among his works are a political novel entitled *Falusi jegyző* (The Village Notary; 1844–46), which was translated into English, and another on *Der Einfluss der herrschenden Ideen des 19. Jahrhunderts auf den Staat* (Vienna and Leipzig, 1851–54). He was minister of public instruction in 1848, but he resigned the same year. In 1865 he began to edit a political paper. In 1867, after the reconciliation between the Magyars and the Emperor of Austria had been effected, he was again appointed Minister of Public Instruction, which place he retained until his death. D. in Pesth, Feb. 3, 1871.

Eozoön [from Gr. ἠώς, dawn + ζῷον, living being]: a peculiar mineral structure supposed to represent an organism, first discovered in the pre-Cambrian or Archean limestones of Canada (see ARCHEAN ERA), composed of concentric layers of dark-green serpentine with interstices filled with calcite or dolomite, or with irregular canals of those minerals running through it. The name was applied to these objects by Sir William Dawson, who interpreted them to be the fossil remains of foraminifer-like organisms, giving the name *Eozoön canadense* to those first described. On account of the great antiquity of the formations (Laurentian) from which they came, and the uncertainty as to the relationship of the structure to any known organism, much doubt has been cast upon the correctness of Dawson's interpretation.

If organic, it represents the most ancient known organism. While some palæontologists and geologists believe it to be organic, many others, and particularly those experts in the knowledge of mineralogy and petrography, consider eozoön to be purely inorganic in origin. H. S. WILLIAMS.

E'pact [from Gr. ἐπακτός, deriv. of ἐπάγειν, intercalate; ἐπί, upon, to + ἄγειν, bring]: the excess of the mean solar month (the twelfth part of a tropical year) over the mean lunar synodical month, or mean lunation—that is, inasmuch as the mean lunation is less than the mean solar month, the epact is properly the amount to be added to the former to bring it up, or make it equal, to the latter. Practically, in the Church calendar, however, the epact is the number of days which intervene between the end of the ecclesiastical year in December and the first day of January succeeding; or, as it is commonly expressed, the epact is the age of the moon, estimated in entire days, at the beginning of the civil year. According to the definition given first above, it is manifest that the epact must increase from month to month, but for the purposes of the ecclesiastical calendar this monthly increase is not considered, the entire increase for each year being supposed to take place at the end of the year. This calendar is extremely artificial, the calendar moon being a sort of fiction of which the periods only approximately correspond with those of the moon in the heavens; so that the calendar months and the true or mean astronomical lunar months rarely begin or end exactly together. In the reckoning of the epact the following arbitrary assumptions are made: 1. The mean synodical month is $29\frac{1}{2}$ days long (it is, in fact, 44 minutes 2·84 seconds longer). 2. The lunar year consists of 12 lunar months, or 354 days. 3. The solar year is always 365 days (it is really 5 hours 48 minutes 46·05444 seconds longer). 4. The calendar months are alternately 30 days and 29 days long. Thus the first day of the second ecclesiastical month is Jan. 31; the first day of the third ecclesiastical month is Mar. 1; of the fourth, Mar. 31; of the fifth, Apr. 29, and so on. Thus the last day of the lunar year is Dec. 20; so that if new moon occurs at the beginning of the civil year exactly, the epact at the beginning of the next civil year is 11. In another year this epact will be doubled and become 22; and at the end of a third it will be 33 days, or more than a month; so that on Jan. 1 the moon will be somewhat advanced in a second lunation. The completed lunation is counted 30 days, and the epact is thus reduced to *three* days at the beginning of the fourth year. The month thus passed over, or dropped, is called an *embolismic* month. As the epacts accumulate, six such embolismic months of 30 days each are dropped; and finally we reach a point where the epact is 29, which we consider to be a complete embolismic month also, and drop it; so that the next following year begins with the epact 0, like the first. This occurs at the end of the nineteenth year, so that in every cycle of nineteen years the epacts recur in the same order.

All the foregoing assumptions are separately inexact, but in combination their inaccuracies nearly balance each other; and accordingly it happens that, at the end of the nineteen-year cycle, the calendar moon, the true moon, and the sun occupy almost exactly the same relative places as at the beginning. That is, supposing the sun and the true moon to leave some determinate point—say the equinox—together at the beginning of the cycle; then at the end of the nineteenth year or the beginning of the twentieth the sun will be truly in the equinox again, and the moon very nearly so, but not quite, being behind by about two hours and four and a half minutes. In something less than twelve cycles (about 220 years), therefore, the true moon will have lost a day on her epact. If the calendar moon lost nothing, its epact would consequently be too great. But the calendar moon loses more than the true moon, as will appear from the following comparison, made for a period of four cycles, or 76 true astronomical (tropical) years and 940 lunations:

940 calendar lunations, of $29\frac{1}{2}$ days each, give...........	27,730 days.
24 embolismic months too long, and 4 too short, add.....	10 "
19 intercalary days, ignored in the lunar calendar.......	19 "
Total days in 4 calendar cycles.....................	27,759.000
" " 940 true lunations......................	27,758.753
" " 76 true years..........................	27,758.407

It thus appears that the calendar moon falls behind the true moon 0·247 of a day, or nearly 6 hours, in 76 years; and its epact not only absolutely diminishes, but diminishes relatively to that of the true moon also. The effect of this is to cause the successive calendar new moons to occur too late by an amount slowly but constantly increasing; the increase amounting to one entire day in something more than 4 times 76, or 304 years—more exactly 308 years. No account of this circumstance was taken, however, for nearly sixteen centuries after the commencement of our era. At the time of the reformation of the calendar by Pope Gregory XIII., in 1582, the epact had become too small by nearly five days. See CALENDAR.

The use of the epact of the year in the calendar of Pope Gregory was to lead to the determination of paschal full moon, and so, by consequence, of Easter. (See EASTER.) The epact being the age of the moon in entire days at the beginning of the (lunar) month, the place of new moon in March would be found by counting backward from Mar. 30 (which we have seen to be the last day of the third lunar month), including this 30th day itself in the count, a number of days equal to the epact. The date in March thus found is the *first* day of the moon, and thirteen days more added brings us to the fourteenth; the day of March thus found will be the date of paschal full moon, unless it happens to be less than the 21st. In this latter case we must go to the month of April, and count backward from the end of the fourth lunar month, which is Apr. 29. To facilitate this counting backward, or to make actual counting unnecessary, Clavius introduced a row of numeral letters into the calendar page opposite the days of the month, in reversed order, I. being opposite Mar. 30, and XXX., or 0, standing opposite Mar. 1. This is extended through all the months in the year, as in the following illustration, which presents the months of March and April only:

Day of month.	MARCH. Epact.	Letter.	Day of month.	APRIL. Epact.	Letter.
1	0, or XXX.	D	1	XXIX.	G
2	XXIX.	E	2	XXVIII.	A
3	XXVIII.	F	3	XXVII.	B
4	XXVII.	G	4	XXVI., 25	C
5	XXVI., 25	A	5	XXIV., XXV.	D
6	XXV.	B	6	XXIII.	E
7	XXIV.	C	7	XXII.	F
8	XXIII.	D	8	XXI.	G
9	XXII.	E	9	XX.	A
10	XXI.	F	10	XIX.	B
11	XX.	G	11	XVIII.	C
12	XIX.	A	12	XVII.	D
13	XVIII.	B	13	XVI.	E
14	XVII.	C	14	XV.	F
15	XVI.	D	15	XIV.	G
16	XV.	E	16	XIII.	A
17	XIV.	F	17	XII.	B
18	XIII.	G	18	XI.	C
19	XII.	A	19	X.	D
20	XI.	B	20	IX.	E
21	X.	C	21	VIII.	F
22	IX.	D	22	VII.	G
23	VIII.	E	23	VI.	A
24	VII.	F	24	V.	B
25	VI.	G	25	IV.	C
26	V.	A	26	III.	D
27	IV.	B	27	II.	E
28	III.	C	28	I.	F
29	II.	D	29	0. or XXX.	G
30	I.	E	30	XXIX.	A
31	0, or XXX.	F			

In this table one peculiarity will attract attention. Though the third lunar month has thirty days, and the fourth only twenty-nine, yet each has thirty epact numbers. There seemed to be a necessity for this; otherwise, when the epact is XXIX. it would be equivalent to zero in the short months (the hollow months as they were called), but not so in the full months. The epacts XXIV. and XXV. are therefore placed opposite the same day. During the same cycle three consecutive numbers like XXIV., XXV., and XXVI. will never all be found among the epacts. When XXIV. and XXV. are both present, XXVI. will be absent; and in that case XXV. is transferred to the place of XXVI., as indicated by the Arabic numeral 25 opposite that epact. Thus, notwithstanding this duplication, two epacts will never fall on the same day of the month.

The use of epacts for finding paschal full moon and Easter is not very convenient. The simple rules given in the article on EASTER will be found much more so. But this is a suitable place to explain how to find the value of the numerical term proper to be used in calculating the date of paschal full moon in the article referred to. The General Table II. of the Prayer-book contains the resultant corrections of the epact for all the centuries from 1600 to 8500. From 1600 to 1700 this correction was zero. From 1700 to 1800, and further from 1800 to 1900, it is 1, and in subsequent centuries it goes on, somewhat irregularly, to increase. Now, the numerical term in the formula given in the article EASTER for computing the date of paschal full moon (when the golden number is odd) is at present 10, from 1600 to 1700 was 9, and after 1900 will be 11. It is, in short, always 9, increased by the correction of the epact found in the General Table II. just mentioned, which for convenience we may call the secular correction of the epact. And an extremely simple rule for finding this numerical term is the following: *From the number of the centuries in the given year of our Lord take its fourth part and its third part (disregarding fractions), and increase the result by* TWO. This is true up to 4200. But in that year and the centuries following, up to 6700, the number of the century must be diminished by *one* before taking the *third* part. In other respects the rule remains unaltered. In 6700 and the centuries following, up to 9200, the number of the century must be diminished by *two* before taking the third part. In 9200, and up to 11,700, the rule is the same as given at first, except that the result is to be increased by *three* instead of *two*. The Gregorian calendar will, however, itself require correction before the year 4000. As an example, let it be required to find the numerical term for the computation of paschal full moon during the century beginning with 4100 and ending with 4200. Putting S for this term, we have

$S = 41 - \frac{1}{4}(41) - \frac{1}{3}(41) + 2 = 41 - 10 - 13 + 2 = 20$. In General Table II. of the Prayer-book we find opposite to 4100 the number 11. And $11 + 9 = 20$, thus verifying the statement made above.

Epaminon'das (in Gr. Ἐπαμεινώνδας, or Ἐπαμινώνδας): Greek statesman and general: b. at Thebes about 418 B. C. He was a pupil of Lysis, a Pythagorean philosopher. His youth was passed in retirement and study. He was temperate and virtuous, and is said to have despised riches. He formed an intimate friendship with Pelopidas. In 385 he served with distinction at the battle of Mantinea, after which he passed many years in private life. He was one of the deputies sent by Thebes in 371 B. C. to a congress of the Grecian states, in which he opposed the policy of Sparta and defended the interest and rights of Thebes in an eloquent speech. War speedily ensued between Sparta and Thebes, and Epaminondas was chosen commander of the Theban army, which amounted to only 6,500 men. He defeated the Spartans at the battle of Leuctra, July 6, 371 B. C., which was fatal to the supremacy of Sparta. In this action he displayed great military genius, and owed his success partly to his novel manœuvers and combinations. He invaded Peloponnesus in 369, and marched against Sparta, which was defended with success by Agesilaus. He commanded the Theban army which defeated the Spartans at the battle of Mantinea, July 3, 362 B. C., but was killed in this action. He left a pure and exalted reputation as a patriot, a statesman, and a sage, and is universally admitted to have been one of the greatest captains of antiquity. Cicero expressed the opinion that Epaminondas was the greatest man that Greece has produced. See Cornelius Nepos, *Epaminondas*; Grote, *History of Greece*, chaps. lxviii., lxix., and lxxx.; and Curtius, *History of Greece*.

Ep'arch [from Gr. ἔπαρχος, governor, used to translate the Lat. *præfectus*; ἐπί, upon, over + ἄρχειν, rule]: in ancient Greece, the title of the governor of a province, a ship's master, a satrap, or the prefect of a region under the Roman rule. The province itself was called an eparchy. In modern Greece the primary subdivision of a nomarchy is called an eparchy. In Russia an eparchy is the diocese or archdiocese of a bishop or archbishop of the Greek Church.

Epaulement [Fr. *épaulement*, deriv. of *épaule*, shoulder < Lat. *spa'tula*]: a military term which, from its derivation, would signify a *side* work, a work to cover *sidewise*—e. g. a *traverse*, or a short parapet made at the flank of a battery or end of a parallel; but practically its meaning is extended to any covering made of earth, stone, wood, or iron, when intended simply as a screen—e. g. to cover cavalry waiting to be brought into action. See Mahan's *Military Engineering*.

Epaulette [Fr. *épaulette*, deriv. of *épaule*, shoulder < Lat. *spa'tula*]: an ornamental article of uniform of military and naval officers, worn on the shoulders; a plate or strap extending along the shoulder from near the collar, and terminating with a fringe of gold or silver bullion, which falls over the shoulder. Rank is indicated by the size of the bullion and by devices on the strap, such as stars, anchors, crowns, etc. In the U. S. army the epaulette is confined to general officers, its place being supplied, for the lower grades, by the "shoulder-knot" of gilt cord, but in the navy it is worn by officers of all grades. The practice varies in the different services of Europe.

Epeira [from Gr. ἐπείρομαι, I examine]: a genus of spiders in which the eight eyes are arranged in two rows, the middle four forming a square; the two anterior pairs of legs are longer than the others, and the abdomen is large, ovoid, and usually brightly colored. Epeira and its allies are known as "orb-weavers," from the fact that they build circular webs with radiating threads and concentric cross-threads. J. S. K.

Epeirus: See EPIRUS.

Epenceph'alon [from Gr. ἐπί, upon, near + ἐγκέφαλος, brain]: See BRAIN.

Eperies, *ā-pā-ri-esh'*, or **Presova** (Lat. *Eperiæ* or *Fragopolis*): an old town of Hungary; the capital of the county of Saros; on the river Tarcza; about 148 miles N. E. of Budapest (see map of Austria-Hungary, ref. 4–I). It is surrounded by walls, and is one of the most beautiful towns of Upper Hungary. It is a bishop's see, has five churches, a college, and manufactures of linens, woolen goods, and earthenware. A royal salt mine is worked in the vicinity. Pop. (1890) 10,400.

Épernay, *ā'pār'nā'* (Lat. *Aquæ Perennes*): a town of France; department of Marne; on the river Marne; about 80 miles E. by N. from Paris (see map of France, ref. 3–G). It is on the railway from Paris to Châlons, 20 miles W. N. W. of the latter. It is well built, clean, and well paved, and has a public library, manufactures of hosiery, earthenware, and refined sugar, and many elegant villas, with wine-vaults. Épernay is a great entrepôt or market for champagne produced in the vicinity. Pop. (1896) 19,377.

Ephebe: See the Appendix.

Ephem'era [from Gr. ἐφήμερος, living but a day; ἐπί, upon + ἡμέρα, day]: a genus of pseudoneuropterous insects, commonly called day-fly, or May-fly, belonging to the family *Ephemeridæ*, and allied to the dragon-flies, or *Libellulidæ*. In the larva and pupa states they live a year or more in the water, but their existence in the perfect state is very brief. They give name to the family *Ephemeridæ*, of which many species occur in the U. S. See ENTOMOLOGY.

Ephem'eris [Gr. ἐφημερίς, diary, journal; ἐπί, upon + ἡμέρα, day]: in astronomy, a table giving the positions of any heavenly body from time to time for a considerable period. Thus we have an ephemeris of the fixed stars, showing the place of the principal stars for every tenth day of the year. An ephemeris of the planets gives the position of each planet, usually for noon or midnight of every day, sometimes also for every transit over the meridian of some one place.

The astronomical tables which household almanacs contain are given with little precision, and are for the most part adapted only to a particular latitude. Such tables are said to have been constructed even in the time of Ptolemy. They were indispensable to the astrologers of later days, who doubtless used them for finding the positions of the planets at some future or past date, and were compiled with sufficient accuracy for their prognostications.

An *astronomical ephemeris* is a collection of such ephemerides for a particular year or series of years, with the times of eclipses, occultations, and other astronomical phenomena, or the means of determining them. The more complete works of this kind are intended to furnish the astronomical observer, whether at an observatory, in the field of a survey, or at sea, with all the data relating to the sun, moon, planets, and some of the principal fixed stars, which he needs to facilitate the prosecution of his work. From the design of some portions of them to the wants of navigators, they are also called *nautical almanacs*.

Such publications were issued by astronomers from the time that astronomy was extensively cultivated as a science. During the eighteenth and nineteenth centuries they have generally been issued by governments, and during the nineteenth century most of the governments of Europe have had some sort of an ephemeris or nautical almanac. Those best known belong to France, Great Britain, Germany, and the U. S.

The earliest astronomical ephemeris noticed in bibliographies is that of Iarchus in 1150; the first printed ephemerides were published in 1475 for the years 1475 to 1506, and in 1499 for the years 1475 to 1531, though doubtless portions were prepared earlier; both were prepared by Regiomontanus. The latter extends through three cycles of nineteen years, and gives the longitudes of the sun and moon, and the phases of the moon and of eclipses occurring from 1483 to 1530, with explanations and useful tables. These have been the precursors of a succession of ephemerides, defective at first, but improving as astronomy advanced.

The *Connaissance des Temps ou des Mouvements célestes*, commenced by Picard for the year 1679, has appeared for each succeeding year, without interruption, to the present time. Additions and improvements were made by La Lande in 1760, who subsequently added lunar distances, with the design of making the book more useful at sea. This and almost all the subsequent volumes have been enriched by valuable memoirs by the most eminent French astronomers, thus carrying out the purpose of La Lande to make this annual a journal of astronomy. For many years it has been prepared under the direction of the Bureau des Longitudes of France. Improvements have been made in it from time to time by the use of more precise tables in its preparation.

The *Nautical Almanac and Astronomical Ephemeris*, published by the British Admiralty, was commenced by Maskelyne for the year 1767. He undertook its preparation, after a plan sketched by La Caille, for the purpose of meeting the wants of navigators, and especially of supplying facilities for using the method of finding the longitude by the distance of the moon from the sun or a star, which Halley had proposed in 1731. Mayer's new tables of the moon for the first time gave the moon's place with sufficient precision to make this method available. The successive annual volumes have been issued, three or four years in advance, to the present time. It was not until 1834 that it came up to the requirements of an astronomical ephemeris. Other improvements and additions have since been made. Under the superintendency of Mr. J. R. Hind, new tables of the sun, moon, and all but two of the planets were introduced, so that it has no superior either as an astronomical ephemeris or an almanac for the use of navigators.

The *Berliner Astronomisches Jahrbuch* first appeared for the year 1776, and has since been continued without interruption. It was mainly designed to supply the wants of astronomers, though those of the navigator were not overlooked. As an astronomical ephemeris it was in advance of all others until the later improvements in its British contemporary. Its volumes contain valuable astronomical memoirs from many of the most distinguished German astronomers.

The preparation of the *American Ephemeris and Nautical Almanac* was begun in 1849 under the superintendence of Lieut. (afterward Rear-Admiral) Davis, U. S. navy, in accordance with act of Congress of the U. S. The theoretical portions of the work were placed under the special direction of Prof. Benjamin Peirce, of Harvard University. The construction of tables of the moon and of some of the planets, with corrected elements and in a form which would facilitate the computation of their ephemerides, was first undertaken, and so successfully accomplished that from its commencement the *American Ephemeris* has ranked among the highest works of this class in extent, completeness, and adaptation to the wants of astronomers and navigators. The first volume was published in 1855. In the preparation of later volumes new and more accurate tables of the sun and planets have been employed. Several of its volumes contain valuable papers by American astronomers. It consists of two parts—the first arranged specially for the use of navigators, and computed for the meridian of Greenwich; the other prepared for astronomers, and adapted to the meridian at Washington. The first part is also published separately. Tables of the moon, Mercury, Venus, the standard stars, and four asteroids have also been published, and new and complete tables of all the planets are in course of preparation, to be used from and after 1900. In 1860 Prof. Joseph Winlock, afterward director of the Harvard Observatory, succeeded Admiral Davis in charge of the work. In 1866 it was placed under the superintendence of J. H. C. Coffin, U. S. navy, who remained in charge until his retirement in 1877. In the latter year Prof. S. Newcomb, U. S. navy, was appointed superintendent. The successive volumes have appeared for each year since its commencement without interruption. Revised by S. Newcomb.

Ephemeral Fever: See Febricula.

Ephemeroptera [from Gr. ἐφήμερος, living but a day + πτερόν, wing]: an order of insects. See Plectoptera.

Ephe'sians, The Epistle of St. Paul to the: one of the books of the New Testament; written probably in the year 61 or 62, during the apostle's first imprisonment at Rome, and about the same time with the Epistle to the Colossians. The words ἐν Ἐφέσῳ, at Ephesus (i. 1), are wanting in the *Codex Sinaiticus* and some other MSS., but the weight of diplomatic evidence on the whole preponderates in their favor. The absence of personal greetings is easily explained by its encyclical character. It is one of the richest and most glowing of the Pauline Epistles. The first three chapters are doctrinal; the last three, hortatory and practical. Of the many commentaries which have been written, those of Harless (German), 1834–58, Eadie (Scotch), 1854, and Meyer and Ellicott (5th ed. 1884) are among the best.

Eph'esus (in Gr. Ἔφεσος; Fr. *Éphèse*): one of the twelve cities of the Ionian confederation; on the river Cayster, which falls into the Gulf of Scala Nova on the western coast of Asia Minor. Its earliest traditions connect it with the birthplace of the goddess Diana, who was worshiped here as the personification of the reproductive and nutritive powers of nature. (See Diana, second article.) Herodotus states that Hercules founded a city in the Ephesian territory B. C. 1250. Androclus the Athenian (B. C. 1044) drove out the inhabitants, and with his followers established a Greek colony. Ephesus increased in importance with the culture of the worship of Diana, which attracted multitudes from all parts, who remained to worship at the shrine of the goddess and to benefit themselves by the commerce of the city, which became the chief mart of Asia and the metropolis. Ephesus was in turn ruled by tyrants, oligarchies, and republics. It paid tribute to Persia for two centuries from the time of Cyrus to Darius III. Ephesus was chiefly remarkable for its magnificent temple dedicated to Diana, which was burnt by Eratostratus in B. C. 356, the day Alexander the Great was born. (See Diana, Temple of.) The Romans finally possessed themselves of this and other cities in Asia Minor (B. C. 41), and under Cæsar Augustus and the succeeding emperors the city was rebuilt. The city was sacked by the Goths A. D. 262. The temple was then destroyed, and from that time the city declined in importance. For many centuries it was in the hands of various adventurers, and it declined into a mere suburb when the Turks built a considerable town at Ayasalouk toward the end of the thirteenth century. See Edward Falkener, *Ephesus and the Temple of Diana* (1862); Fergusson, *The Temple of Diana at Ephesus* (1883); Wood, *Discoveries at Ephesus* (1877), of which an abstract appeared in 1890 entitled *Modern Discoveries on the Site of Ephesus.*

Ephial'tes: the name of a famous giant in the Greek mythology, said to have been a son of Neptune.

Eph'od [Heb. *ēphōd*, deriv. of *āphad*, to put on]: a Jewish robe or tunic worn originally by the high priest (Exodus xxviii. 4); afterward by all priests (1 Sam. xxii. 18). It was made of fine linen. The ephod of the high priest had a breastplate attached to it containing twelve precious stones, on which were engraved the names of the twelve tribes. The relation of these twelve stones to the Urim and Thummim is still an open question.

Eph'ori, or **Eph'ors** [from Gr. ἔφοροι, overseers; ἐπί, upon + root Ϝορ-, watch, cf. ὁρᾶν, see]: the title of magistrates common to many of the Dorian states of ancient Greece. In the political constitution of Sparta the ephors exercised supreme power. The Spartan ephors were five in number, and were elected from the body of the ruling caste. Their term of office was one year. Besides their judicial authority, they exercised a control over the functions of the kings and the senate, and sometimes recalled the former from their foreign expeditions. They negotiated treaties with foreign states, and possessed nearly all the executive power of the government. The office was abolished by Cleomenes III., who came to the throne 236 B. C.

Ephorus of Cyme, in Asia Minor: Greek historian; b. about 400 B. C.; pupil of Isocrates, who said that Ephorus needed the spur, as Theopompus the bit. Ephorus began as a rhetorician, but at the suggestion of his master made history the work of his life, and prepared a universal history in thirty books (professedly omitting the mythical age), from the return of the Heracleidæ (*q. v.*) to the siege of Perinthus (340 B. C.). Each book had an introduction and was complete in itself. It was a famous work, much valued and read on account of the wealth of its material. A man of words not deeds, neither soldier nor statesman, Ephorus was the first of the closet historians. Nor was his critical faculty great. His style has a rather lazy flow; yet he was a popular author. Polybius has an occasional good word for him, and he is a favorite source of Diodorus. See Klügmann, *De Ephoro historico* (1860). Fragments in Muller's *Fragmenta Historicorum Græcorum* (vol. i., pp. 234–277). B. L. Gildersleeve.

Ephraim (double fruitfulness, Gen. xli. 52): one of the Hebrew patriarchs, second son of Joseph, and the head or founder of one of the twelve tribes of Israel. The territory of the tribe of Ephraim extended from the river Jordan to the Mediterranean Sea, and was bounded on the N. by Manasseh and on the S. by Benjamin and Dan; and was about 55 miles from E. to W. by 70 from N. to S.

E'phrem (or **Ephraim**) **the Syrian**: ecclesiastic and writer; b. probably about 308 A. D. at Nisibis, in Asia Minor. He was a zealous opponent of Arianism and other heresies; became a hermit or anchorite in the prime of life, and lived in a cave near Edessa. He was venerated as a saint and a prophet by his contemporaries, and received the offer of the bishopric of Edessa, but declined it. He wrote in Syriac numerous religious works, among which are hymns and commentaries on Scripture. His poetry is metrical, with occasional use of rhyme and assonance, and he is fond of the acrostic arrangement. But of his many works only a small number exist in the original Syrian text, the rest surviving in Greek, Latin, Armenian, and Slavic translations. It is doubtful whether he himself understood Greek; the Greek versions of his works, however, are certainly translations. A complete list of his writings is given by I. S. Assemani in the *Bibliotheca Orientalis* (i. 59–164), and in the preface to the Roman edition of the Greek text of his works. The principal edition of the Syrian and Greek texts is that which appeared in Rome in 6 vols. (1732–46), under papal authority; 3 vols. Greek text with Latin translation, and 3 vols. Syrian text, also with Latin translation, by the brothers Assemani. The hymns and sermons were published, with Latin translation, by T. J. Lamy (Mechlin, Belgium, 1882–89). A German translation of a selection of his works was published by Zingerle (6 vols., 1830–37). English translation of selections by J. B. Morris (Oxford, 1847) and of hymns and homilies by H. Burgess (London, 1853). D. 373. Revised by C. H. Toy.

Epicharmus: Greek comic poet and thinker; b. in the island of Cos about 540 B. C.; emigrated to Sicily in early childhood; settled in Syracuse, and died at the age of ninety. The Pythagoreans claimed him as a member of their order on the strength of his wise sentences, and it was on this account that Plato ranked him in comedy with Homer in epic. Epicharmus gave artistic form to Sicilian comedy, of which the great features are the travesty of mythology and the representation of typical characters from daily life. His language is the local Doric dialect, and the "rapidity" said to be characteristic of his comedies is ascribed now to his verse, now to his plot, now to both. Scant fragments are to be found in Ahrens, *De Græcæ linguæ dialectis* (vol. ii., appendix). See Müller's *Dorians*; Lorenz, *De Epicharmo* (1864). B. L. Gildersleeve.

Epic Poetry, or **The Epos**: poetry which narrates a series of adventures or events, usually of an heroic or supernatural order. No thoroughly satisfactory definition of epic poetry, however, has ever been given. Perhaps as good as any is that of the Italian scholar Pio Rajna, "any poetic narration of memorable things" (*Le Origini dell' Epopea francese*, p. 3): yet it would be easy to find critical objections to this. All authorities are agreed that an epic poem must be a narrative, and of an imaginative rather than literal kind; but as to the kind of "memorable things" suited to such narrative there remains great divergence of opinion. It is best therefore to pass from a theoretical to an historical view of the subject.

Even a slight study of existing epics, so called, brings out the fact that under this name are included poems of very different characters, at least in so far as the method of their genesis is concerned. On the one side are works like the *Iliad* and *Odyssey*, of a singularly objective and impersonal kind; on the other, poems like the *Æneid*, the *Gerusalemme Liberata*, and *Paradise Lost*, which are the products of individual geniuses, working in perfectly well-known conditions, and impressing their own personalities upon all that they write. When we try to pass from the works of Homer to Homer himself, and to imagine what manner of man he was, we find ourselves instantly at a loss. We can not even determine whether he was one or many, much less distinguish his personal opinions, sympathies, or qualities. All we are sure of is a certain poetic matter laid out before us with the noblest and most beautiful art. The poet has completely sunk himself in his subject, and has apparently taken no thought of preserving his own name and fame. And this subject, this poetic matter, furthermore, is evidently not something of the poet's own contrivance or invention. It existed and was esteemed before him; so that it was enough for him to present it as clearly and charmingly as he could. It belonged to his audience, not to him; and his audience required of him that he should be in the highest sense true to it. His office was to revive and fix in beautiful forms certain precious memorials cherished by all persons of his race and time. Hence the impersonality of the product. Accordingly, all that is left is the study of the poem, not of the poet.

This compulsory transference of attention to the subject-matter of poems like the *Iliad* and the *Odyssey* makes still clearer the difference between them and poems like the *Æneid*. The former are essentially the spontaneous and natural expression of the ethical and imaginative life of a whole society, a whole race; the latter are the products of a personal and intellectual art. Nor is this all. A still deeper study of the genesis of the great popular epics shows us that they are the perfected result of long poetic preparation, of what M. Gaston Paris has well called "*une fermentation épique*" (*Litt. française au Moyen Âge*, p. 36, 1890). Behind them are not epic models, but epic experiments, and experiments in the same line as themselves. In the "personal" or "literary" epics, on the other hand, even the greatest, there are everywhere the signs of imitation, of the effort to come up to standards evidently derived from without. Homer, whoever he was, thought only of telling again the familiar heroic story of Troy; Milton was concerned quite as much with preserving in his poems the true epic manner—the manner of Homer and Vergil—as with telling of the Fall and the Redemption of man.

The scientific study of epic poetry must begin therefore with the investigation of such periods of poetic preparation, or "epic fermentation," as produced or might (but for accident) have produced great spontaneous and natural epics. The chief of these periods are undoubtedly that which in Greece culminated in the *Iliad* and the *Odyssey*, that which in India culminated in the *Mahâbhârata*, and that which in mediæval France produced the *Chansons de Geste* (of which the *Chanson de Roland* is the best representative). Besides these, however, we have numerous periods when essentially the same processes were going on among other peoples, though the product was either through obstructing causes rendered less complete, or was less directly and perfectly the outcome of the epic fermentation itself. Thus among the Celts, both Cymric and Gaelic, a true epic material was developed far toward ultimate fullness and power; but the unhappy fortunes of the Celtic race left this material to be used by aliens. Among the Anglo-Saxons, as the poem of *Beowulf* shows us, only the premature (in the poetic sense) invasion of Christianity prevented the creation of great national works. Among the Scandinavian peoples we have in certain of the lays of the *Elder Edda* and in parts of the *Volsunga Saga* (though the latter is in prose) a near approach to epic success. The Spaniards began the preparation of material for epics, as the *Poem of the Cid* and the ballads prove; and apparently only the attraction of foreign culture (that of Provence and France and Italy) for the upper class, separating it in its imaginative life for a time from the mass of the people, caused this material to be left unused, except upon a minor scale. The Slavic races have rich funds of heroic matter peculiar to themselves; but they also too early came under the influence of other more developed peoples, and have made little use of their own. The mediæval and modern Greeks, too, show traces of the matter from which epics are formed. On the other hand, the Germans saw their heroic traditions, which Christianity with its accompaniments of classical education and French culture had caused to be in the main neglected from the time of Charlemagne down to the twelfth century, revived and embodied in two great poems, the *Nibelungen* and the *Gudrun*. But in these innumerable evidences of the influence of foreign social and literary ideals testify to a gap in the continuity of true epic creation. Again, the Persians have in their *Shah-Nameh* a work which only a long previous poetic working over of the traditions of the race could have made possible. Yet the author of it, Firdausī, was after all a court poet, belonging to a circle of such, and too much of an artistic individual, too much of a scholar, to be a perfect representative of epic art. Finally, the Finns possessed in their popular lays heroic matter of considerable epic possibilities; but the *Kalevala*, in which Lönnrot, a modern scholar familiar with Wolf's hypothesis and all the discussions of the philologists, has attempted to weld these lays into an epic whole, is far from fulfilling the requirements of an epic masterpiece of the spontaneous and natural kind.

Still, much may be learned of the genesis and nature of epic poetry from the study of all these periods and works. Far the richest of the periods for this purpose is undoubtedly that of the production of the French *Chansons de Geste*. To be sure, there were produced then no works of the incomparable excellence of the *Iliad* and the *Odyssey*. But the latter stand at the very beginning of Greek literature, not merely not preceded or accompanied by other poems of a similar character, but not even lighted up by hints in contemporary literature of other kinds. All we can learn of the manner of their production must come through the analogy of other epic periods, confirmed by the internal evidence of the poems themselves. In mediæval France, on the contrary, though on many points we know far too little, we yet have information and hints enough to reveal the birth of a splendid and powerful art. There we can follow the process by which the actual life of a race is transformed into imaginative life, by which real persons and events acquire an ideal character, and by which the enthusiasms, the aspirations, the dreams of a whole society come to embody themselves in poetic form. It is worth while, then, briefly to describe this process, as the results of critical investigation have made it known to us, because it must be taken as typical of what took place wherever epic poetry has grown or began to grow.

The true origin of French epic is not to be sought before the time when the invading Germans had practically destroyed for the great body of the population of Gaul the culture of the Roman world. These Germans, as Tacitus and other writers tell us, and as we know from remains of their own early poetry, were in the habit of celebrating in songs the gods, the heroes, and the great achievements of their race. (See Pio Rajna, *Le Origini dell' Epopea francese*, Florence, 1884.) Among them these songs and the singers of them had an almost sacred function. Nor were only ancient traditions thus preserved; new heroes and their deeds were sung as they appeared. When the Germans had possessed themselves of their new homes in the former Roman world, they did not forget this habit of theirs. Those of them who had remained in the German land continued to transmit from generation to generation their purely national songs. These Charlemagne knew and loved, and he had a collection of them made which unhappily is lost to us, though the legends themselves lived on. Those Germans, however, who had settled in the more southern territory, in the midst of a population more numerous than they, did not find it easy to retain their ancient traditions. The presence, too, of large numbers of popular artists—mountebanks, players, singers—perhaps diminished the dignity of the old Germanic poet. He became rather a popular entertainer than a prophet and sage. Yet he did not lose the tradition of his art. He still seized upon great names and great deeds, and rendered them into songs. We have many testimonies to the existence of such songs. They even attracted the attention of would-be serious persons, and, as Pio Rajna has beautifully shown, the pages of Gregory of Tours, Fredegarius, and the *Gesta Regum Francorum* abound in passages in which the Merovingian kings are transformed into poetic rather than historical characters. These kings, however, were not as yet representative of the patriotic and moral life of the French people. Indeed, the French people was not as yet constituted—its political and social institutions were still in confusion, its ideals of conduct were only beginning to form themselves, it had not yet felt an impulse of united and patriotic zeal. Not till the time of the Carolingians did the effort against the Saracens make the people one; not before Charles Martel and Charlemagne did the people find leaders of truly heroic proportions. From the time of these monarchs therefore must be dated the determinate poetic agitation that was finally to produce French epic. By the side of Charlemagne and the Carlovingians, to be sure, memories of other leaders and of events in which the great family had no part were preserved. Yet it is not too much to say that the existence of the poems devoted to these memories was largely due to the interest and incitement of the Carolingian story. Exactly in what form these epic traditions were handed down we unfortunately do not know. There has been much controversy among scholars over the so-called *cantilenae*, as the contemporary Latin writers call the poems about popular heroes. Some have imagined that these were short ballads, similar to the existing Spanish ballads dealing with separate episodes of story, and that finally the completed epics were composed by welding together series of such *cantilenae*. This is evidently an echo of the Wolf-Lachmann hypothesis about the formation of the *Iliad* and *Odyssey*. Others (chief among them Pio Rajna) have supposed that the *cantilenae* were in themselves incipient epics, and that from the constant reworking of these our epics came. Be this as it may, what is certain is that parallel with the constitution of mediæval French society went on the constitution of the imaginative matter of which the French epics were to be made. By the middle of the eleventh century this new society was essentially complete. The population of the land had become one; it had arranged itself in feudal classes; the higher of these classes was working out a new ideal of individual and social life—what we call the chivalric ideal. The nation was becoming conscious of itself and proud of its own past as well as of its present. Among the upper classes there was wealth, and splendor, and delight in courtly life and something of leisure. These were the conditions necessary for the maturing of the epic fruit that had been so long perfecting itself. In the end of the eleventh century this fruit began to appear, and one of the first, as well as finest, specimens of it was the *Song of Roland*, a truly heroic rendering of an episode connected with Charlemagne's career. During the next century epic production went on in France with ever-increasing rapidity. These poems were found to have an immense attraction for all classes in society, and the popular singers, the *jongleurs*, saw their fortune made by the amplification in verse of the history of every available hero or event that had left a trace in the popular memory. To such a pitch were interest and curiosity roused that not merely the great heroes and their legendary achievements were described, but gradually the need was felt of enlarging knowledge about them, and whole cycles of poems were devoted to the heroic deeds of ancestors and descendants—deeds most of them pure and arbitrary inventions of the singers. The constant need of new materials even led to the use of stories having no connection with the national history, and thus tales of the heroes of ancient Greece and Rome, and epic legends of the Celts, became a part of the narrative literature of France.

The process that has just been described enables us to arrive at important deductions as to the manner in which all great epics are generated. The creation of poems like the *Song of Roland*, the *Iliad*, the *Mahâbhârata* demands in the first place a certain condition of national culture and feeling. The races that produce them must have passed through stirring experiences, must have had striking leaders, and must proudly have preserved the memory of them. Then a certain state of society seems to be necessary. The social organization must be aristocratic, and in the upper class there must be wealth, splendor of living, and some degree of leisure, for though the populace may remember fragments of old legend, and enjoy the poetic rendering of them, it will not have the time or patience for amplified versions of them. Then this rich and splendid upper class must feel its own pride engaged and stirred by the national traditions, and must delight in listening to them dressed out as splendidly as its entertainer, the minstrel or poet, knows how. All this implies a society considerably advanced in culture, and yet it must not have advanced so far as to produce or be interested in distinct and powerful personalities in the realm of thought or art. All its ideals of greatness must still belong to the realm of action, and the poet must still feel that his matter is of infinitely more importance than himself—that, great as may be his honor if he hold and please his audience, it is not because *he* is memorable, but rather because he represents for the moment the noblest recollections and ideals of the persons to whom he sings.

When such a society as this, addressed by such poets, has formed itself, or, better, is in process of forming itself, the poetic successes of these poets will be transmitted from generation to generation by word of mouth. At first they will be crude, disjointed, undiscriminating. As time goes on certain of them will be found to have superior attractions for audiences; and naturally such will be given the preference. The themes of these will become the popular themes, and will throw into the shade the less interesting. Thus the process of natural selection will be initiated, and the themes that survive will be treated with greater and greater fullness. Successive poets, seeing the opportunity to fill here and there a gap, will do so. They will transfer to the narrations they find most popular episodes from others that are less popular and are about to be abandoned. Thus the strong themes devour the weak—as in mediæval French epic one Charles, Saturn-like, swallows up another. And by these processes of exclusion and contamination, as well as by the purely inventive additions of successive singers, the strong themes enlarge and perfect themselves. And at last the time comes when both the themes and the society to which they are addressed have reached the right point of development for poets of a larger aim to appear—poets who will venture to bring together into extensive wholes the materials prepared by their predecessors. These wholes will be epic poems in the proper sense of the word; and out of many such a few will by accident of happy theme and inspired singer have such transcendent beauty and power as to be remembered, and at last written down and preserved.

The application of these principles to other epics than the

Chansons de Geste must rest, as has already been indicated, to a considerable extent upon analogy. In the case of the *Iliad* and the *Odyssey* we have absolutely no hint as to the epic process until it appears in its perfection in these masterpieces. Yet the poems themselves upon examination bear out well the theory in its essential elements. The Homeric ἀοιδός clearly corresponds in every important detail with the French *jongleur*. Like him he is an entertainer, though perhaps with somewhat more of dignity. Like him he addresses an aristocratic society, proud of its past, loving splendor, and having leisure which must be adorned. Then the very persistence among scholars of the theory which Wolf suggested (*Prolegomena ad Homerum*, 1795), and which Lachmann amplified in his so-called *Kleinlieder-Theorie*, however wild the applications of it may often have been, would seem to be proof enough that the matter of the Homeric poems has not the unity and consistency of an effort of an individual imagination. On the contrary, there appear in it traces of the long and various working over of traditional materials. Finally, all that we know of the later reciters of Homer, the rhapsodists and Homeridæ, as well as of the cyclic poems, corresponds well with our information about the later *jongleurs* and the crop of French genealogical poems of the twelfth and thirteenth centuries.

If we turn now to the *Mahâbhârata*, we shall obtain the same results, though it may be said that we have here more hints as to the preliminary processes than is the case with Homer. It is certain that in India heroic song was from immemorial antiquity cultivated at the courts of princes and generally among the knightly class (*Kshatriyas*). In the *Mahâbhârata* itself the transmission of epic legend is connected with the Sûtas, a caste which resulted from the union of *Kshatriya* men and *Brâhmana* women, and which supplied charioteers and heralds as well as professional minstrels. The legends which these minstrels made use of were partly historical, partly mythological, in their character. But in India, as in Greece, it was rather history than mythology that was the mainspring of epic song. Divine beings, whatever their origin, must be associated as determinate individuals with men before they can be employed in an epic action. The singer looking back into antiquity discovers gods involved by every possible tie of relationship and interest with his heroes, and he naturally does not discriminate between the two in his story. It will hardly do, after the fashion of certain ardent mythologists, to allow the mythical elements of epic to assume the more important *rôle*, and attempt to resolve everything else into mythology.

Already in the later Vedic literature we find specimens of the material later used in the *Mahâbhârata*. Such material is there called *Itihâsa*, *Purâna*, or *Âkhyâna*—that is, tales, old stories, or legends. Some of these tales are reproduced bodily in the *Mahâbhârata*; and that the whole of this poem was felt to be little more than a collection of such is shown by the fact that the supposititious author is in the poem itself called *Vyâsa*—"arranger," or "diaskeuast." In fact, in the now enormous whole of 100,000 slokas, or double verses, there are evidences (confirmed by the testimony of the poem) of three distinct handlings, and perhaps of a complete reversal of the original political and religious tendency. Furthermore, we find there matter both of the original epic impulse and of the later explanatory and amplificatory kind. It is as if we had the *Iliad* and *Odyssey* fused into one with the cyclic poems, or the *Chanson de Roland* combined with the long list of poems of the *Geste du Roi*. All this, however, but makes the *Mahâbhârata* the more significant for the student of the genesis of epic poetry.

Did the limits of this article permit, these investigations might be pursued in the other epic periods of which mention has been made, and in all the facts would be found to agree with those outlined above. In Persia Firdausī based his *Shah-Namah* on collections of old Iranian traditions that had begun to be made before the conquest of Persia by Islam. (See Firdausī.) Among the Celts we have bards (*file*, the Irish called them), corresponding on one side at least to the ἀοιδοί and the *jongleurs*, using the combined historical experiences and mythological traditions of the race for the elaboration of the epic stories of heroes like Arthur and Tristram. Among the Germanic peoples we have the *Scôps*, maintainers of the memorials of the past, and producing poems like *Beowulf*, giving shape to materials that were later and under different conditions to be used for the *Nibelungen* and *Gudrun* in Germany, the *Eddas* and the *Volsunga Saga* in the Scandinavian lands. Among the Finns alone do we seem to find somewhat different conditions. Their lays are rather a possession of the whole people than of a class of singers appealing to an aristocratic upper class. Yet here, too, it is national pride that preserves them, and they are consecrated to the memory of a period of struggle against the inferior Lapps and of conquest over them. It may be remarked also that but for the peculiar circumstances that produced a modern scholar like Lönnrot, no Finnish epic in the large sense would ever have been born.

Such being the manner in which the great spontaneous popular epics are born, the question remains what connection there is between them and that other class of epics of which mention has been made—the "personal" or "literary" epics. The gap between the two kinds is certainly a wide one, yet perhaps not so wide as would appear at first sight. The latter are indeed due to efforts of individual genius striving to render after the great epic models subject-matters of personal interest and choice. Yet even so, it will generally be found that where success has been attained the part of tradition has been greater than would *a priori* be supposed. As society advances in culture beyond the point at which spontaneous epic production is possible, as experience and reflection increase the dignity of the individual, and especially of the artist, it is natural that efforts should be made to obtain personal honor and fame by the imitation of works that have general renown. In almost every country where epics have been produced we find this tendency. In India the traditional *Mahâbhârata* is succeeded by epic forms written by single known poets. These are known as Kâvyas, the works of *kâvis*, i. e. definite poets. The most famous of these is the *Râmâyana*, written by Vâlmîki, which in certain ways is so near the old tradition as to be almost a great popular epic. The traces of the individual hand, however, everywhere appear in it, and historical legend is allegorized according to the tendencies of a single mind. Later than the *Râmâyana* we have a series of Indian epics frankly artistic in character, two of them ascribed to the famous dramatist Kâlidâsa. These with four others have been called by Indian rhetoricians *Mahâkâvya*, or great poems, as especially worthy of study. The subject matter of all six, however, is drawn from the *Mahâbhârata* or the *Râmâyana*. In Persia the success of Firdausī's great work led to other attempts by court poets in the same line. First, additional episodes in the national history were treated, and especially the heroic deeds of the members of the family of Rustem. Then other heroes were celebrated, and the series of would-be epics extends down into the nineteenth century.

Leaving the Orient for the Occident the same tendencies are observed among the Greeks, though in a less marked degree, because the growth of other powerful poetic forms, as well as the very unsurpassableness of Homer, made the temptation to imitate him less. Still epics continued to be written, such as the *Heracleia* of Pisander of Cameirus, the *Heracleia* of Panyasis, uncle of Herodotus, the *Thebais* of Antimachus of Colophon, the *Perseis* of Chœribus of Samos, the *Argonautica* of Apollonius the Rhodian, the *Dionysiaca* of Nonnus, and the *Sequel to Homer* (τὰ μεθ' Ὅμηρον) of Quintus Smyrnæus. Not in Greece, however, but in Rome the first great literary epic was written—the *Æneid* of Vergil. And here it is worth noting that although for Vergil the epic form and manner are matters of imitation, not of direct poetic inheritance, yet in a certain way the conditions of his writing approximate those of true epic creation. It was a kind of new national pride and hope that animated him, and he recited traditions that had become associated with the noblest ideals of the Latin race. He freely used, too, the works of his predecessors—Nævius, Ennius, Attius, A. Furius of Antium, and probably others. Still, undoubtedly, the plan, the structure, the coloring of the *Æneid* are all his own; and we feel its success to be of a very different order from that of the *Iliad*. Of the Latin epics subsequent to Vergil—the *Pharsalia* of Lucan, the *Punica* of Silius Italicus, the *Thebais* and *Achilleis* of Statius—it is unnecessary to speak in detail. In them the double imitation of Homer and Vergil alone gives semblance of epic value.

After the fall of the Roman empire, with the decline of the literary life in general, literary epics ceased for a time to be written. This, indeed, was what made possible the birth of that spontaneous mediæval epic which has already been described. One material only, subsequently to be used by great masters, began to assume its epic shape—the story of the fall and the redemption of man as told in the Old and New Testaments. Beginning with the poetic version of the four Gospels by the Spanish Juvencus (330 A. D.), this material was gradually brought into epic form during the fourth and fifth centuries. (See AVITUS.) Here, too, the imitation of Vergil determined the manner of treatment. After the mediæval period proper had come to an end, and the great return to the study of antiquity which we call the Renaissance had restored to man a sense of his individual power and worth, there was an immediate revival of the writing of literary epics. Homer and Vergil had now become the great masters in this kind of composition, and fame was assured for any one who could, even if not rival, at least seem to approach the standard of these poets. The number of epics since the Renaissance is almost countless, and they still continue to appear.

In his *Essai sur la Poésie épique*, affixed to the *Henriade* (1732), Voltaire, after discussing Homer, Vergil, and Lucan, deems the following modern epics worthy of mention: The *Italia Liberata* of the Italian Trissino, the *Lusiads* of the Portuguese Camoens, the *Gerusalemme Liberata* of Torquato Tasso, the *Araucana* of the Spanish Alonzo de Ercilla, the *Paradise Lost* of Milton. It may perhaps be doubted whether the *Italia Liberata* and the *Araucana* have maintained their position as epics of universal interest, so hard is it for single imaginations to fulfill the work of many. If, however, these names must be stricken from Voltaire's list, two or three others should perhaps be added. Of these the *Henriade* itself, despite its contemporary repute, is hardly one. It has great merits, but it is dull. There can be little hesitation, however, in placing in the list the *Messias* of the German Klopstock; and, on the whole, the name of another poem belongs there—one of the most famous and popular of modern Europe, though in some ways romantic narrative rather than true epic—the *Orlando Furioso* of Ariosto. Still another great example of essentially epic work we have had of late years in the librettos of the musician Wagner.

It is worth noting that in this list as it remains the majority of the works are those in which epic tradition has still a great part. The *Paradise Lost* and the *Messias* belong to that long line of Bible epics whose beginning has already been noted. Wagner's greatest librettos renew the Germanic legends of which the *Nibelungen* is made. The *Orlando Furioso*, as may be seen in Pio Rajna's learned and charming book (*Le Fonti dell' Orlando Furioso*, Florence, 1876), gives us a romantic and ironical rendering of the story of that same Roland who is the hero of the *Chanson de Roland*. Born in France, this story had passed over into Italy, taken new root in the twelfth and thirteenth centuries, lived on in the popular imagination, and, finally, in the Renaissance, been treated by the grotesque Pulei in his *Morgante Maggiore* and the satirical Boiardo in his *Orlando Innamorato*. By this long route did it come into Ariosto's hands. At the last, therefore, we have but two poets left, Tasso and Camoens, who can be said to have transformed by efforts of their single imaginations historical themes into epic works of acknowledged power. And even these poets, though they had not the co-operation of the popular imagination, were inspired by the religious enthusiasm and patriotic pride of their fellow men.

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A. R. MARSH.

Epicte'tus (in Gr. Ἐπίκτητος; Fr. *Épictète*; Germ. *Epiktet*; Ital. *Epitetto*): Stoic philosopher; b. at Hierapolis, in Phrygia, about 60 A. D. He was in his youth a slave of Epaphroditus, a favorite of the Emperor Nero, and lived at Rome. He became a freedman, and was banished with other philosophers from Rome by Domitian in 89 A. D., after which he lived at Nicopolis in Epirus. He was a man of excellent moral character, and acquired a high reputation as a teacher of philosophy, but he wrote little if anything. His temper and doctrines were less austere than those of most other Stoics, and were essentially Christian in their nature. It does not appear, however, that he had any connection with the Christian Church, or that he was a believer in the mysteries of that religion. Among his favorite maxims was "Suffer and abstain." His disciple Arrian collected his maxims and doctrines; his manual called *Enchiridion* has been translated into English by Mrs. Carter (1758), and by T. W. Higginson (1865). See Ritter, *History of Philosophy*; G. Boileau, *Vie d'Épictète et sa Philosophie* (1655; in English by J. Davies, 1670); Farrar, *Seekers after God* (1869).

Epicurean Philosophy: a system of philosophical teaching which took its name from Epicurus (337–270 B. C.), its founder. It originated in a reaction against the teachings of Socrates and his followers. Throughout the period of Greek decline and the last ages of republican Rome it exercised a profound influence, which was perpetuated through the days of the Roman empire, in spite of the opposition of Stoicism and of Christianity. It is a remarkable fact that it always remained substantially as Epicurus left it.

The writings of Epicurus are lost, with the exception of fragments chiefly preserved by Cicero, Seneca, and Diogenes Laertius, but the sublime poem of Lucretius, *De Rerum Naturâ*, is an exposition of the teachings of Epicurus.

In theology, Epicureanism was essentially atheism. The gods were eternal, immutable, and entirely unconscious of human affairs. Human responsibility for wrong-doing was consequently reduced to the minimum. The highest positive duty was made to be the pursuit of pleasure—not necessarily sensual enjoyment, for Epicurus himself taught that repose was the highest pleasure. Whatever the virtues of Epicurus may have been, the results of his system of ethics were thoroughly bad. The moral corruption of ancient Greece and Rome was in part the fruit of this system. The genial temper, the elegant habits of life, and the moral indifference exhibited in the writings of Horace were among the least objectionable of the effects of the Epicurean teachings.

The physical doctrine taught by Epicurus and Lucretius was not unlike that of certain modern evolutionists. They held that matter is uncreated, indestructible, and that all material things were self-evolved, without a supervising or directing Intelligence. See Lucretius, *De Rerum Naturâ*; Gassendi, *Syntagma Philosophiæ Epicuri*; and Henne's article *Epicure* in the *Dictionnaire des Sciences Philosophiques*.

Epicu'rus (in Gr. Ἐπίκουρος): Greek philosopher; founder of the EPICUREAN PHILOSOPHY (*q. v.*); b. in the island of Samos in 337 (or, as some say, 341) B. C. He was a son of Neocles, an Athenian, and is said to have been a pupil of Xenocrates, but he professed to be self-taught. At the age of eighteen he visited Athens, afterward traveled in Ionia, and opened a school at Mitylene, where he taught new doctrines. About the year 307 he removed to Athens, where he purchased a garden and founded a celebrated school of philosophy. He was very popular as a teacher, and gained a great number of disciples. He recognized pleasure as the chief good, and consequently was calumniated by the Stoics, but it appears that his habits were temperate and virtuous. Epicurus took no part in political affairs. He wrote numerous works on ethics, natural philosophy, etc., which are not extant, but several of his letters have been preserved by Diogenes Laertius. His opponents admitted that he was personally amiable and virtuous. Knowledge of his doctrines is derived chiefly from the works of Cicero and Lucretius, who in his poem *De Rerum Naturâ* amply illustrates his philosophy, and expresses great admiration of Epicurus. Among the eminent men who favored Epicurean principles were Horace, Atticus, Gassendi, Rousseau, and Voltaire. D. in 270 B. C. See Gassendi, *De Vita et Moribus Epicuri* (1647); Ritter, *History of Philosophy*; Zeller's *Stoics, Epicureans, and Skeptics.*

Epicycle [Gr. ἐπίκυκλος; ἐπί, upon + κύκλος, circle]: in ancient astronomy, a circle having its center moving along the circumference of another circle. It was a favorite opinion of the Greek astronomers that all the celestial motions must be uniform and circular, because the circle is the most perfect of plane figures. The phenomena of the stations and retrogradations of the planets were apparently inconsistent with this notion; and in order to explain them, Apollonius of Perga imagined the theory of *epicycles* and *deferents.* He supposed every planet to move uniformly in the small circle, or epicycle, the center of which is carried uniformly forward along the circumference of the large circle or deferent, of which the earth occupies the center. Hipparchus, having discovered the eccentricity of the solar orbit, supposed the motions to be performed in eccentric circles. The celebrated astronomer Ptolemy adopted the hypotheses both of Apollonius and Hipparchus; that is, he supposed the earth to be placed at a small distance from the center of the deferent circle (which consequently was called an *eccentric*), and the planet to move uniformly in the epicycle, the center of which also moves uniformly in the deferent. By means of these suppositions, and by assigning proper ratios (determined by observation) between the radius of the deferent and the radius of the epicycle, and also between the velocity of the planet in the epicycle and the velocity of the center of the epicycle on the deferent, he was enabled to represent with considerable accuracy the apparent motions of the planets, and particularly their stations and retrogradations. As a first step toward connecting the sciences of astronomy and geometry the hypothesis of epicycles does great honor to its inventors.

Epicycloid [from *epicycle* + *-oid*, a suffix from Gr. εἶδος, form]: a curve traced by a point on the circumference of a circle which rolls on the convex side of a given fixed circle. It belongs to the class of curves called roulettes, and is not invariably a transcendental curve. It is always of a finite order when the circumferences of the two circles are commensurable. The normal of the epicycloid is easily constructed; it always coincides with the line which joins the generating point to the corresponding point of contact of the two circles. The evolute of the epicycloid is a similar epicycloid, the radii of the circles being merely altered in a certain ratio. When the circles are equal the epicycloid is similar, and similarly placed to the pedal of the fixed circle with respect to a point in the circumference. The curve is the cardioid, which is the inverse of a parabola. The epicycloid was invented by Romer, the Danish astronomer, who about 1674 proposed this curve as the best form for the teeth of wheels, in order to prevent friction. Newton gave its rectification in his *Principia.*

Epidam'nus: See DURAZZO.

Epidau'rus (in Gr. 'Επίδαυρος): an ancient town of Greece, on the east coast of the Peloponnesus and on the Saronic Gulf, about 45 miles S. W. of Athens. It was an independent state, and possessed a small territory called *Epidauria.* As early as 600 B. C. it was one of the chief commercial cities of the Peloponnesus. It derived much importance from its temple of Æsculapius (situated 5 miles from the town), which was one of the most celebrated sanctuaries in Greece, and was frequented by patients from all of the Hellenic states seeking a cure for their diseases. Here are the ruins of a magnificent theater, 370 feet in diameter, with fifty-five rows of seats. Once in four years, nine days after the Isthmian games at Corinth, a festival was celebrated here in honor of Æsculapius, with musical and gymnastic games. On or near the site of Epidaurus is a small village called *Neá-Epidavro*, or Pidavro, at which the first national assembly of modern Greece assembled in 1822, and drew up the instrument known as the Constitution of Epidaurus.

Epidemics [from Gr. ἐπιδήμιος, among the people, sojourning among; ἐπί, to, upon + δῆμος, people; the word commonly implies, as does also the verb, ἐπιδημεῖν, the sojourning of foreigners, as distinguished from ἔνδημος, ἐνδήμιος, native; hence the distinction *epidemic* versus *endemic*]: Diseases which appear from time to time in a certain locality and spread widely, affecting large numbers of people. *Endemic* diseases, on the other hand, are such as are constantly met with, isolated cases occurring now and then. Many epidemic diseases are endemic in certain countries where the conditions are eminently favorable, as in the case of cholera, which is endemic on the deltas of the Ganges, and yellow fever, which is constantly present in certain of the South American states. Some affections are apparently only epidemic, but the number of such is exceedingly small. Certain diseases which are endemic as a rule become epidemic when atmospheric or other influences predispose the community to general infection. This is seen in the U. S. in the case of typhoid fever and dysentery, as well as other diseases. An interesting instance in point is the epidemic spread of malaria which sometimes attends extensive excavations along the banks of rivers, where malaria, originally prevalent, became unknown as the result of suitable drainage.

The study of epidemics and the causes leading to them is one of the most interesting and important branches of medical history and pathology, and has occasioned the widest differences of opinion. This was largely the result of ignorance of the causes of the various epidemic diseases, and has been to a large extent removed by a fuller knowledge of micro-organisms and their relation to disease. Formerly atmospheric and telluric conditions, such as humidity, winds, the character of the soil, soil moisture, and the like, were given the most prominent place in the causation of epidemics; but, though there are still some who maintain the pre-eminence of these causes, the majority of hygienists are now strongly inclined to regard them of secondary importance to the actual causes, micro-organisms. The study of epidemiology is therefore intimately concerned with that of bacteriology on the one hand and preventative medicine on the other hand, and a knowledge of the causes of epidemics has in many instances led to almost complete eradication of certain diseases. This was seen in the case of scurvy, formerly the scourge of seamen and of armies, but now unknown excepting where the grossest carelessness or untoward circumstances prevent a suitable dietary. In the case of childbed fever, which in certain places and at certain times has attained epidemic characters, the practice of antiseptic precautions has almost exterminated the disease.

Diseases which are epidemic are for the most part of the group designated as infectious, and which are considered to be due to certain micro-organisms. Of these diseases, some, as typhoid fever, diphtheria, and scarlet fever, are also included among the contagious diseases—that is, they are communicated to other individuals by mere contact, while others, as typhoid fever, cholera, and malaria, are non-contagious, and are never communicated directly from person to person, excepting through water, food, or other matters infected by the affected individual. Exact lines can not be drawn between non-contagious and contagious diseases, and in the case of certain diseases there is doubt as to the class to which they belong.

Aside from epidemics of infectious diseases there are sometimes curious epidemics of mental or nervous diseases, some of which in a measure are exaggerations of what are generally recognized as waves of popular belief. Thus from time to time a war spirit prevails, as in 1770 to 1795 or in 1848. The crusades were in a measure instances of epidemic mental influences. The children's crusade was an extreme instance, bordering on a pathological condition. Epidemics of dancing mania, of witchcraft, of suicide, and the like are distinctly cases of mental aberrations.

Sometimes certain diseases are associated and prevail as epidemics simultaneously. This was the case with typhus fever and spotted fever in several epidemics, and is not infrequently noted in the case of other diseases. On the other hand, it is occasionally noted that one disease follows another in epidemic form, and by successive plagues whole populations may be exterminated. A study of the epidemics of the thirteenth, fourteenth, and fifteenth centuries gives abundant evidence of this.

As a rule, the first period of an epidemic is the worst, for susceptible individuals fall an easy prey, but sometimes the latter days are worse than the onset. As there is a difference in the severity of the disease from time to time in an epidemic, so there may be differences in different epidemics. Every physician recognizes that the typhoid fever of one epidemic is by no means of the severity of that in another outbreak, and the same thing is even more noticeable in the case of diphtheria or scarlet fever.

Curious cycles are often observed in the outbreak of certain epidemics, and it is noted that smallpox, cholera, and other diseases appear at somewhat regular intervals. A partial explanation of this may be found in the fact that persons once affected are for the most part immune from subsequent attacks, and that an interval must pass before new susceptible individuals have grown up. This is manifestly but a partial and imperfect explanation.

Epidemics spread from place to place in various ways. Sometimes the poison is carried by affected persons, by clothing, or by food, and it may be noted, as in the case of cholera, that the disease extends along the lines of travel and with the rapidity with which travel is effected. Other epidemics, as typhoid fever, are carried along water-ways, and infection is generally accomplished through drinking water. In another class, to which influenza notably belongs, dissemination occurs through the air, and so widely that the term " pandemic " is appropriately applied.

Fortunately the knowledge of certain principles regarding infectious diseases gives promise of extermination of epidemics in a way quite different from these before referred to. These principles, which are strikingly exemplified in vaccination, indicate the possibility of protective inoculation against other diseases, and the possibility of rendering man immune from infections of all kinds. Much patient work remains to be done in this direction, but the sciences of bacteriology and pathological physiology have opened the channels of experimentation. See CLIMATE.

WILLIAM PEPPER.

Epiden'drum [from Gr. ἐπί, upon + δένδρον, tree]: a large Linnæan genus of epiphytic orchids, which, as originally constituted, includes the vanilla and many other species. The species, about 400 in number, abound in the tropics and many have very showy flowers. The only tree orchids native to the U. S. belong to this genus. The *Epidendrum conopseum* grows principally upon magnolia-trees, and is found in South Carolina, Georgia, and Florida. Several species are confined to Florida. The blossoms, although rather pretty, are not conspicuous.

Epider'mis [Gr. ἐπιδερμίς, the outer skin; ἐπί, upon + δέρμα, skin]: called also **Cuticle**, or **Scarf-skin**; in anatomy, a modification of the epithelium, accurately molded to the papillary layer of the true skin or derma. When exposed to pressure and friction it becomes hard and thick, as in the palms of the hands; otherwise it is soft. It is composed of agglutinated, flattened cells, but in the deep layers the cells are rounded or cuboidal, and filled with soft contents. In most races of men these deep cells contain more or less pigmentary matter, which gives the skin its various shades from black to white. The epidermis is penetrated by the ducts of the sweat-glands and oil-glands of the skin. Its cells are developed by multiplication of the cuboidal cells of the deeper layers. The hair and nails in man, and also the horns in lower animals, are modifications of the epidermis. See HISTOLOGY.

The epidermis in plants is a layer of thick-walled cells, of character varying extremely in different species. It is entirely homologous in structure with animal epidermis. Upon leaves it is penetrated by the stomata, and both transmits exhalations and absorbs carbonic acid, the most important part of the plant's food.

Epidote [as if from Gr. *ἐπίδοτος, deriv. of ἐπιδιδόναι, to superadd; ἐπί, upon + διδόναι, give—said to be so named because the series of the secondary forms are an enlargement on the base of the primary]: a mineral which consists essentially of silica and alumina, combined with portions of lime, oxide of iron, or peroxide of manganese. Some of the clear varieties are used as gems; these are chiefly from Untersulzbachthal, in the Tyrol. Epidote occurs in the crystalline rocks of the Eastern U. S. at many places, but not of gem quality. A variety containing lime is called *zoisite*, and another containing manganese is termed *pistacite*. It is often found crystallized in prisms, and sometimes occurs massive. The color is generally some shade of olive color, from nearly black to golden green, yellow, brown or red.

Revised by G. F. KUNZ.

Epigæ'a [from Gr. ἐπίγαιος, upon the earth; ἐπί, upon + γαῖα, earth]: a genus of plants belonging to the *Ericaceæ* or heath family, and comprising two species. *Epigæa repens*, popularly known as trailing arbutus, is a prostrate plant with evergreen and heart-shaped alternate leaves and clusters of rose-colored or white flowers, which appear in early spring and exhale a delightful fragrance. It is found in sandy woods, especially under evergreens, sometimes in rocky soil, and ranges from Canada to Texas. In New England it is somewhat inappropriately called mayflower, and in the Southern States ground laurel. The plant has diuretic powers. The other species of *Epigæa* is Asiatic.

Epiglot'tis [Gr. ἐπιγλωττίς; ἐπί, upon + γλῶττα, tongue; so named in allusion to its position]: the lid which closes the entrance to the larynx during deglutition. It is composed of fibro-cartilage covered with mucous membrane. During respiration the epiglottis is vertical, and in the act of swallowing it automatically falls backward and downward and closes the larynx, thus preventing the passage of food into that organ. Revised by WILLIAM PEPPER.

Epig'oni [Lat. form of Gr. ἐπίγονοι, those born afterward, descendants; ἐπί, upon + root γεν-, be born, become]: literally, successors or heirs; a collective appellation of the sons of the seven Greek chiefs who conducted the expedition against Thebes. Their names were Alcmaeon, Thersander, Diomedes, Ægialeus, Promachus, Euryalus, and Sthenelus. They renewed the war and took Thebes. Æschylus made the story of these chiefs the subject of a tragedy, *The Seven against Thebes*. In the history of literature the name is sometimes applied to those writers who confine themselves to the further development of the ideas of the great masters of the classic period.

Epigram [from Gr. ἐπίγραμμα, an inscription, an epitaph, a short pithy stanza such as those used in epitaphs; ἐπί, upon + γράφειν, write]: originally an inscription or brief writing; a short poem or piece of verse which has only one subject, and ends with a witty or ingenious turn of thought; an interesting idea expressed happily in a few words. The Greek epigram was at first a short collection of lines inscribed on a monument or statue, and the word was afterward transferred to short poems suitable for inscriptions. The general characteristics of Greek epigrams are perfect simplicity and the seemingly studied absence of that *point* which characterizes the modern epigram. But perhaps this seeming pointlessness is due to our ignorance of the circumstances under which they were written and to which they allude. It appears that the first and indispensable requirement of an epigram is not brevity nor sharpness, but *antithesis*. Epigrams are nearly all in one form of metre, the elegiac. Some of the epigrams of Catullus and Martial present the modern epigrammatic character; and Martial has in fact afforded the model on which the modern epigram has been framed. The French writers have been more successful in epigrams than any other modern writers, and they excel especially in those which are intended to be satirical and piquant.

Epigraphy [Gr. ἐπιγραφή, inscription; from ἐπί, upon + γράφειν, write]: the science of deciphering and explaining INSCRIPTIONS (*q. v.*).

Epig'ynous [from Gr. ἐπί, upon + γυνή, a female]: a botanical term applied to stamens and petals which grow on the summit of the ovary. These sometimes appear to be inserted on the ovary, in consequence of the coherence of the calyx with the ovary.

Epilepsy [from Gr. ἐπιληψία, ἐπίληψις, seizure, epilepsy; ἐπί, upon + λαβεῖν, seize]: a chronic disease of the nervous system characterized by short periods of unconsciousness, with or without convulsive movements; called also FITS and FALLING SICKNESS. It has been known since the earliest times, and its history is closely associated with that of witchcraft and sorcery. It was long thought to be of supernatural origin, and its victims were looked upon with mingled awe and fear. It is only within the nineteenth century that epilepsy has been studied scientifically. But little is known of its causation. It is more apt to begin in childhood. Direct inheritance plays a smaller part than is popularly supposed, but insanity, drunkenness, and hysteria in the parents strongly predispose to it. Fright, over-eating, worms, teething, are all said to be causative. Cases have been cured after the removal of foreign bodies from the ear, cutting out a painful cicatrix, and circumcision. Such instances are, however, very rare. The seat of the disease, it is quite well established, is in the gray matter of the surface of the hemispheres of the brain. There are three varieties of epilepsy: *petit mal*, *grand mal*, and Jacksonian, or local, or focal epilepsy.

In *petit mal* there is momentary unconsciousness without convulsion. Often the patient feels faint, or has a sensation of vertigo. He drops whatever he may have in his hands, ceases speaking, and turns pale, with eyes wide open and staring. In a moment consciousness returns, and he continues whatever he may have been doing.

Grand mal presents a very different picture. Often the patient can foretell an attack by means of a localized sensation called an *aura*. The commonest aura is an uneasy sensation in the pit of the stomach. There may be, however, simply a feeling of terror, a flash of light, or a distinct visual hallucination. In one case the patient always saw a landscape. Again, there may be noises or sounds of music or voices in the ears. Almost immediately after the aura the patient cries out, falls unconscious, becomes rigid for a moment, and then is seized with violent convulsive movements of the entire body. The eyes roll, the lids open and shut, and the face is livid and contorted into the most horrible grimaces. Froth, mixed perhaps with blood from the bitten tongue, escapes from the mouth. After a few minutes the convulsion ceases. A profound stupor succeeds, and the breathing is deep and noisy. After a time the patient can be aroused, but if left alone he will sleep for some hours. Sometimes fit follows fit rapidly, without the patient ever regaining consciousness, producing the condition called *status epilepticus*. Death usually follows from exhaustion. Epileptic convulsions are sometimes followed by curious mental phenomena. The patient may pass into a condition of trance in which, like a somnambulist, he may perform the most complicated acts without any subsequent recollection. Again a fit may be followed, or even replaced, by an attack of acute mania, in which the patient may have homicidal or suicidal tendencies. This is a fact of great moment in medical jurisprudence, as no doubt many apparently causelesss and motiveless assaults are committed while in this condition. The tendency in epilepsy is toward chronic mental degeneration, though it may accompany the soundest intellect. Napoleon, Peter the Great, and Julius Cæsar were all afflicted with it. Indeed, the Italian school of psychologists claim that genius is an epileptical degeneration; but of this there is no sufficient evidence. Napoleon was a genius in spite of epilepsy, not because of it.

One of the rarer forms of the disease is the so-called *epilepsia procursiva*, which is characterized by attacks of violent running, either in a straight line or a circle, sometimes ending by a fall and coma. In *epilepsia nutans* there are nodding movements of the head from side to side, and up and down, lasting a few moments.

In *epilepsia loquax* the patient repeats time and again some one word.

In *Jacksonian epilepsy* consciousness is unaffected, and the spasm is localized to one extremity or side of the face. It is usually due to a gross localized lesion in the motor region of the brain—a tumor, abscess, meningitis, or injury.

The treatment of epilepsy depends upon the cause and the variety of the disease with which the patient is affected. During the fit the clothes should be loosened, and the patient only restrained enough to prevent his injuring himself.

William Pepper and Charles W. Burr.

Epilo'bium [from Gr. ἐπί, upon + λοβός, lobe of ear, pod], or **Willow Herb**: a genus of herbaceous perennial plants of the family *Onagraceæ*, natives of temperate and cold climates. They have eight stamens and four petals. The fruit is an elongated many-seeded pod or capsule. Some of the species bear beautiful flowers. The *Epilobium angustifolium*, a native of Europe and of the U. S., has showy pink-purple flowers, and is sometimes planted in gardens. Several other species are indigenous in the U. S. The popular name willow herb was given in reference to the leaves, which resemble those of a willow. These leaves have astringent properties, and are reputed to have other active powers.

Epilogue [from Greek ἐπίλογος, closing discourse as in a drama or oration, in contrast to πρόλογος, introduction; ἐπί, upon + λογός, discourse]: in dramatic poetry, the closing address to the audience at the end of a play. It was usually spoken by one of the actors, and was cheerful and familiar in tone. The term is sometimes applied to the conclusion of an oration.

Epim'achus [apparently from Gr. ἐπίμαχος, assailable, that may easily be attacked; ἐπί, upon + μάχη, battle]: a genus of birds belonging to the *Paradiseidæ*, or birds of paradise, having a slender bill, densely feathered nostrils,

Epimachus speciosus, or grand plume bird.

and a long tail. Sometimes made the type of a separate sub-family, the *Epimachinæ*. Two species are known, the largest being the grand plume bird (*Epimachus speciosus*), an inhabitant of New Guinea. This magnificent bird is a little over 2 feet in length, of a velvety black above and below, with touches of coppery green about the head and back. On each side of the breast is a fan-shaped tuft of plumes tipped with a band of steel blue. The two central tail feathers are steel blue, and other parts of the plumage are marked with metallic reflections. F. A. Lucas.

Epimen'ides (in Gr. Ἐπιμενίδης; Fr. *Épiménide*): Greek poet and prophet; a native of Crete; flourished about 600 B. C. According to tradition he fell asleep in a cave, and awaked after a lapse of more than fifty years, with a large increase of wisdom and inspiration. A poem on the voyage of the Argonauts is ascribed to him. At the request of the Athenians, who were afflicted with the plague, he visited Athens about 596 B. C. and purified that city. Goethe wrote a poem called *Des Epimenides Erwachen*.

Epime'theus [Gr. Ἐπιμηθεύς, so named in presumed contrast to *Prometheus*, as if to mean *after*-thought as opposed to *fore*-thought]: in the Greek mythology, a brother of Prometheus and the husband of Pandora. His daughter Pyrrha became the wife of Deucalion.

Épinal, *ā'pēe'naal'*: town of France; capital of the department of Vosges; pleasantly situated at the western base of the Vosges Mountains, on both sides of the Moselle, about 200 miles E. S. E. of Paris (see map of France, ref. 4–II). It is defended by three forts, and has a ruined castle, a fine Gothic church, a theater, a hospital, a public library, a museum of pictures and antiquities, and manufactures of cutlery, paper, hosiery, lace, chemicals, pottery, and linen fabrics. Pop. (1896) 26,525.

Épinay, *ā'pēe'nā'*, LOUISE FLORENCE PÉTRONILLE DE LA LIVE, Madame d': author; b. in France about 1725. She was married at an early age to her cousin, M. d'Épinay, but they were soon separated. She was intimate with Rousseau, for whom she built the hermitage at Montmorenci, and with Friedrich Grimm. Her work on education, entitled *Conversations of Émilie* (1783), gained a prize of the French Academy. D. Apr. 17, 1783, leaving autobiographic memoirs (3 vols., 1818). See Fallu, *La Marquise d'Épinay* (1866); Perey, *Jeunesse de Madame d'Épinay* (1882).

Epiphania: See HAMAH.

Epipha'nius (in Gr. Ἐπιφάνιος; Fr. *Épiphane*), SAINT: a bishop and theologian; b. at Besanduke, near Eleutheropolis, in Palestine, about 310 A. D. He was educated in Egypt by monks, who instilled into his mind ascetic notions, and became afterward a disciple of Hilarion. In 367 he was made Bishop of Constantia (formerly Salamis), in the island of Cyprus. He was an adversary of Origen, whom he denounced as a heretic, and he co-operated with those who deposed Chrysostom. He wrote, besides other works in Greek, a treatise against heresies, entitled *Panarium*, which is one of the most important sources of information for the history of the ancient Christian Church. The best edition of his works is by W. Dindorf (5 vols., 1859–63). D. on board ship returning home from Constantinople, in the spring of 403. See R. A. Lipsius, *Zur Quellenkritik des Epiphanius* (Vienna, 1865).

Epiph'any [from Gr. ἐπιφάνεια, appearance, manifestation, also from ἐπιφάνια (sc. ἱερά) neut. plur., the Christian festival of the manifestation, deriv. of ἐπιφαίνεσθαι, appear]: a festival in the Christian Church, celebrated the twelfth day after Christmas (Jan. 6), to commemorate four events: (1) Christ's baptism; (2) his birth; (3) his manifestation to the magi; (4) the manifestation of his divinity in the miracle at Cana. Later, especially in the Western Church, it popularly commemorated the visit of the three wise men to the infant Jesus. It was Eastern in its origin, and to-day in the Greek and other Oriental Churches it is the season for baptisms and of the solemn blessing of the waters. The eve of Epiphany, called Twelfth Night in England and Three Kings' Night in Germany, was anciently a great popular festival. Its celebration is still kept up. In the English and American Prayer-books services with collects, epistles, and gospels are provided for six Sundays after the Epiphany.

Epipharynx: See ENTOMOLOGY.

Epiphe'gus [from Gr. ἐπί, upon + φηγός, oak, used here inaccurately in sense of its Lat. cognate *fāgus*, beech-tree]: a genus of herbs of the family *Orobanchaceæ*. They are root-parasites growing apparently from the ground, but really from the roots of trees. This genus is found only under beech-trees (whence the name *beech-drops*); the herbs are purplish or yellow brown, slender branched, with scale-like leaves, and from 6 to 12 inches high. The *Epiphegus virginiana*, common in the U. S., is called cancer root, from the idea that it is curative of cancer.

Epiphyte [from Gr. ἐπί, upon + φυτόν, plant]: a plant which attaches itself to the bark of trees, and derives nourishment chiefly from the air, whence the popular name of air-plant. Such plants are found generally in tropical countries, and prefer moist and shady situations. The orchideous epiphytes are cultivated with great success in greenhouses. Many of them are of exquisite beauty, and others are remarkable for their grotesque forms.

Epi'rus, or **Epei'rus** (in Gr. Ἤπειρος; Fr. *Épire*): a country of ancient Greece; bounded E. by the chain of Pindus, S. by the Ambracian Gulf, and W. by the Ionian Sea. It corresponds to the southern portion of the modern Albania, a wild and mountainous region which in all ages has been occupied by semi-civilized and robber tribes, called *Epirots* or *Epirotes*. It is adapted to pastoral pursuits, and its fine horses, oxen, and Molossian dogs were celebrated in antiquity. The three most important tribes of Epirots were the Chaones, Molossi, and Thesproti. The Molossi eventually became the masters of all Epirus. Among the Molossian kings was Alexander, whose sister Olympias was married to Philip of Macedon. The most celebrated king of Epirus was PYRRHUS (*q. v.*), under whose reign this kingdom attained its greatest power and splendor. He waged war against the Romans in Italy. D. in 272 B. C. Epirus became a Roman province in 168 B. C., and was conquered by the Turks in 1466. The chief towns of Epirus were Ambracia, Buthrotum, and Dodona. This region is still frequently called Epirus or "the Epirus." See Merleker, *Das Land und die Bewohner von Epirus* (1841).

Episcopal Church, The Protestant: the religious body formerly known as "the Church of England in America," and generally styled by Bishop William White, long its revered presiding bishop, the "American Church," or by the Connecticut churchmen in convocation in 1783 the "American Episcopal Church." The full legal title of this communion is "The Protestant Episcopal Church in the United States of America," a name originally assumed at an informal meeting of three Maryland clergymen and twenty-four vestrymen in 1780, it has been surmised, to distinguish it from those Christians, on the one hand, who acknowledge the papal supremacy, and from those, on the other, who reject the authority of bishops. Whether this were really intended or not is perhaps doubtful; the name, however, describes with sufficient accuracy the relations of this Church to the other religious bodies in the U. S.

The Episcopal Church is the descendant and representative of that branch of the Church of England which was established in the North American colonies in the seventeenth century. The English adventurers of that and the preceding age, like the Spaniards and Portuguese, carried their national religion with them, and introduced it wherever they gained a footing. The instructions given to Sir Humphrey Gilbert in 1578 gave him authority to settle in any country which was not in the possession of any Christian prince. He was to govern his colonies by laws agreeable to the policy of England, and not against the Christian faith professed in the Church of England. This expedition terminated, indeed, in disaster and in the death of the commander: but similar principles guided all expeditions which set sail for the "western parts of America."

The first services of the reformed Church of England within the territory now occupied by the U. S. were held probably at Point Réyes, Drake's Bay, on the California coast, in June and July, 1579. Francis Fletcher, priest and preacher of the little company in the Golden Hind, in which Sir Francis Drake at this time circumnavigated the globe, records in the *World Encompassed* the use of the Church's prayers on the eve, or on the festival, of St. John Baptist, June 24, at which service sailors and savages were the worshipers, and the crew of the Golden Hind besought their God in behalf of the natives attracted to these solemn rites that He would "open their blinded eyes to the knowledge of Him, and of Jesus Christ the salvation of the Gentiles." Fletcher records the maintenance of services for the six weeks of the adventurers' stay, and notes the auriferous nature of the soil, a fact not fully revealed until California had become a part of the U. S., and was freed from the controlling influence of the Latin civilization and the Latin faith.

A little later, on the Atlantic coast, in Raleigh's colony at Roanoke, N. C., on Aug. 13, the ninth Sunday after Trinity, 1587, Manteo, an Indian chief, who had visited England twice and was friendly to the settlers, was baptized according to the Prayer-book form, and a week later Virginia Dare, daughter of one of the assistants of the colony, Ananias Dare and Eleanor his wife, "the first Christian born in Virginia," was also baptized. In the summer of 1605 Waymouth's expedition, when off the coast of Maine, had natives at the daily prayers "who behaved themselves very civilly, neither laughing or talking all the time."

In 1607 an expedition under the command of Capt. Newport, of which the Rev. Robert Hunt, a man of energy and ability in civil affairs, as well as a learned and devout divine, was the chaplain, made a successful settlement at the mouth of the James river, Va. Under his guidance and the supervision of the saintly Hunt the foundations of the Church in Virginia were laid, and, although it doubtless suffered from his early death, it gradually increased in strength and influence, and became the established religion of that colony. In the same year, at Sagadahoc, on the coast of Maine, the first church building erected by the

English race on the North American continent was built within the walls of Fort St. George, and the Rev. Richard Seymour, a priest of the English Church, ministered here thirteen years before the landing on Plymouth Rock. In Maryland, and in what are now called the Middle States, the Church of England was introduced at an early date. In New England, where Puritanism had a predominating influence, the churchmen of the seventeenth and eighteenth centuries were longer in gaining a footing, which, when gained, they were obliged to make good against determined opposition.

Without tracing the history of the Church through the colonial period, it may be sufficient to say that, notwithstanding many drawbacks, it had in the year 1776 gained a very respectable position. It had been all along, however, obliged to contend not only with open enemies, but with injudicious friends. The violent measures of Andros and others had tended in some places to increase the dislike to the English Church which was felt by the Puritans of New England and New York, and by the numerous sectaries who, attracted by Lord Baltimore's proclamation of a general toleration, had swarmed into Maryland. The attempts which were made from time to time to procure bishops for America had failed, principally from political causes, and the Church, thus deprived of the presence of the highest order of its ministry, was necessarily crippled in the performance of its functions. The want of bishops threw difficulties in the way of raising up a native ministry. Young men who sought holy orders were obliged to make a long and perilous voyage to England to be ordained, and they were fortunate if they returned in safety. The smallpox in the eighteenth century was the peculiar scourge of the colonists who visited England, and this disease, justly dreaded in those days, carried off many of the most promising of the young men. The devotion of colonial churchmen, however, to their religion continued firm and unwavering, and although they encountered further trials at the time of the Revolution, they were able not merely to overcome them, but to place their Church in a position which has enabled it ever since to increase in influence and members.

At the beginning of the Revolutionary war there were in the Middle and Eastern States about eighty parochial clergymen. These gentlemen, with the exception of those in the great cities, were for the most part dependent for their support upon the Society for the Propagation of the Gospel. This society, however, withdrew its gifts after the termination of the war. In other respects, also, the conclusion of peace left the Church in a depressed condition. Although the large body of church clergy and laity were on the side of the friends of freedom, still many of the clergy and laity had adhered to the crown during the struggle, and most of these at its close withdrew themselves to England or to the colonies which continued "loyal." The peace was soon followed by the confiscation of the landed endowments of the Church in Virginia, and the numerous churchmen in that State were thrown upon their own resources. The Church was poor, and its prospects were not hopeful.

Two important measures were immediately necessary—to obtain the episcopate, and to promote a closer union between the churches in the several States. The first was necessary to the existence, the second to the well-being, of the Church. Under the old confederation the States regarded themselves as independent sovereignties, and by consequence the churches in them conceived themselves to be so many national churches. This position, if it had continued, would not indeed have affected their faith and doctrine, which are unchangeable, but it might nevertheless have produced many inconveniences. By the principles of the Church of England, every national church, while it is bound to adhere to the common faith of Christendom as a heritage from the apostles, has a wide liberty in regulating its own ceremonial, discipline, and worship. Thus the Prayer-book might have been altered in a different way in different States, and divergences in discipline and government might have been developed to such an extent as to make the relations between the churches an alliance rather than a union. This danger was averted, almost by an accident. A few clergymen from New York, New Jersey, and Pennsylvania met at New Brunswick, in New Jersey, to take measures for reviving an old society (which still exists) for the support of the widows and children of the clergy. They naturally discussed the condition of the Church, and made arrangements for a larger meeting to be held soon afterward in New York, to which representatives of the laity were to be invited. This meeting, however, did little more than lay down certain general principles—with reference particularly to episcopacy and the Common Prayer-book, which they rightly conceived would tend to promote a real union between the churches in the several States—and issue a call for a similar meeting to be held the next year in Philadelphia. This was the beginning of the General Convention, which has ever since been regarded as the governing body of the Church in the U. S.

The constitution of this body, as it was soon afterward established, required it to consist of all the bishops, and of four clergymen and as many laymen from each State. By later amendments, when more than one bishop was placed in a State, every diocese or episcopal jurisdiction became entitled to a representation of four clerical and four lay deputies, and the lay deputies were required to be communicants. All the bishops were entitled to seats *ex officio*; and it was arranged that as soon as there should be three or more they should sit in a separate house. Every act was to receive the approbation of both houses. Authority was given to the General Convention to prescribe the qualifications for ordination and to set forth a Book of Common Prayer—the two things that were most necessary for establishing such a union as was desired. It was also directed that there should be a convention in every State, consisting of clergy and laity, the powers of which were not in any way defined. It seems to have been assumed, however, that these conventions were to exercise supervision over the affairs of the Church in every State—or, to use the more recent expression, in every diocese—in all matters not coming within the immediate jurisdiction of the bishop.

This constitution was adopted in the several States, though not immediately in all. The convention of 1785 had consisted of delegates from what were afterward called the Middle States, and from Maryland, Virginia, and South Carolina. Much doubt was felt in the East, particularly in Connecticut, as to the wisdom of some of its legislation. The introduction of the laity especially, into what was conceived to be a Church council, was regarded as an experiment of questionable expediency, and some of the powers which were given them were thought to be without precedent. These objections, however, were gradually obviated or waived; and in 1789 Bishop Seabury, with a deputation from the churches in New England, took his seat in the General Convention, and the union of the Episcopal churches in the U. S. was completed. Although the constitution proposed in 1785, and adopted in an amended and completed form in 1786, all along contemplated the presence of bishops, there really were none in the U. S. at that time except Bishop Seabury, who took no part in the proceedings of these conventions. This gentleman (the second of a family which for five generations has furnished a line of clergymen, all able and some distinguished) had been sent to England soon after the peace by the clergy of Connecticut to obtain consecration. Ten of the Connecticut clergy had met on the Feast of the Annunciation, Mar. 25, 1783, at Woodbury in that State, and had chosen Dr. Seabury as their bishop, instructing him to seek consecration first in England, and failing there to go to Scotland for the coveted apostolical commission. In England he had found an obstacle, however, in the oath of allegiance, which forms a part of the English consecration office, and which, of course, could not be taken by any one but a British subject. After some delay, and much negotiation, he succeeded in obtaining consecration from the Scottish bishops on Nov. 14, 1784, at Aberdeen, and, returning to the U. S. in 1785, was received as Bishop of Connecticut and, later, of Rhode Island.

The rule of the Church, believed to have come down from the apostles themselves, requires the presence of at least three bishops at every consecration; and it was necessary that there should be at least that number in the U. S. to maintain an episcopal succession. Application was therefore made in 1786 to the English bishops in behalf of the Rev. William White and the Rev. Samuel Provoost who had been chosen to the episcopate in Pennsylvania and New York. The obstacle arising from the oath of allegiance was removed by an act of Parliament; but a new difficulty was found in a revised Prayer-book known as the "Proposed Book," which had been proposed for use in the U. S. in 1785, and in which the English bishops thought that they perceived indications of a disposition to depart from the doctrine of the Church of England. After a correspondence between some of the most learned divines in England and the U. S., in which the principle was clearly brought out that "this Church does not intend to depart from the Church of England in any essential point of doctrine, discipline, or worship, or further than local circumstances require," it was agreed to proceed with the consecration of these gentlemen, and they were accordingly consecrated bishops on Feb. 4, 1787, in the archbishop's chapel at Lambeth, by the Most Rev. John Moore, Archbishop of Canterbury, assisted by other bishops. Partly because it was desirable that there should be more than the lowest number of bishops necessary to maintain a succession, and partly to keep up the succession in the English line, the Rev. James Madison obtained consecration in 1790 as Bishop of Virginia.

The "Proposed Prayer-book," as it was called, which had never met with much favor, was allowed to fall into oblivion, and it has now become one of the curiosities of ritual literature. A new revision of the Prayer-book was made as soon as the union of the churches was effected. The English Prayer-book was followed, with such alterations as were necessary to adapt it to the changes in the political condition of the country, and with many other (chiefly verbal) modifications. The promise, however, to adhere to the doctrine, discipline, and worship of the Church of England was, upon the whole, strictly adhered to. The most important changes were the introduction of a communion office closely resembling that of the Scottish Episcopal Church, and more nearly approaching the older liturgies of England, which was done at the request of Bishop Seabury and at the instance of the Scottish bishops, in fulfillment of an implied pledge indicated in the "Concordat" agreed to at his consecration by Bishop Seabury and his Scotch consecrators; the omission of the Athanasian Creed; and the leaving out the precise directions about confession which occur in the English Office for the Visitation of the Sick. This omission was perhaps balanced, and the mind of the Church sufficiently declared, by the stringent rules about confession which are found in the Office for the Visitation of Prisoners, borrowed from the Irish Prayer-book. The Prayer-book, thus revised, was ratified in 1789. It came into immediate and general use, and has been for a century, without material alteration, the "use of the Church in the U. S." A revision begun in 1883 and finally consummated at the General Convention of Oct., 1892, in the adoption of a carefully prepared "Standard," was conducted on conservative lines, returning to the English use in restoring the *Magnificat* and the *Benedictus* and other English services left out in 1789; adding proper prefaces in the Office for the Holy Communion and additional selections of psalms, increasing the number of occasional prayers and thanksgivings and making many verbal changes, in no case, however, affecting statements of doctrine. The new Standard was published at Easter, 1893. It is now in general use.

The two objects which the convention had in view in 1785 were thus attained in 1789. There was a sufficient number of bishops, and the union of the Church in the U. S. was perfected. Since that time 170 bishops have been consecrated, of whom 84, including 4 retired missionary bishops, were living in 1900. There are upward of 4,250 priests and deacons, and the number of registered communicants is 714,575. The Church has extended into every State and Territory, and its missionaries have penetrated into Western Africa, Greece, China, Japan, Mexico, Brazil, and Cuba. In the General Convention of 1789 (that in which the union of the Church was perfected) 2 bishops sat, with 29 clerical and lay deputies. That of 1892 consisted of 73 bishops and 467 clergymen and laymen. The number of churches and chapels is estimated at about 6,600. There is a general theological seminary in the city of New York, and there are divinity schools in Connecticut, Illinois, Iowa, Massachusetts, Minnesota, Ohio, Pennsylvania, Virginia, and Wisconsin. Several colleges are connected with this church, among which are Trinity College, Hartford, Conn.; Hobart College, Geneva, N. Y.; Griswold College, Davenport, Iowa; Racine College, Wis.; St. John's College, Denver, Col.; and Burlington College, New Jersey. The University of the South was begun some years before the civil war, and has been revived, endowed, and developed into one of the most promising institutions of learning in the land. Faculties of divinity and grammar schools are attached to several of the colleges. St. Stephen's College, Annandale, N. Y., receives at an early age youths who are designed for holy orders, and carries them to the point at which they begin their theological training. Lehigh University, South Bethlehem, Pa., is under church control. Trinity School, New York, an endowed grammar school established in 1706, receives seventy-two boys on the foundation.

The doctrine of the Episcopal Church is that of the Church of England, believed to have been the common faith of Christendom while it continued undivided. The relations of this Church to the rest of Christendom were clearly defined by the bishops who met in conference at Lambeth in 1867, in 1878, and again in 1888. In 1868 more than seventy bishops from England, Scotland, Ireland, the colonies, and the U. S. met in that year to take into consideration the state and best interests of the churches of the Anglican communion. One of their first acts was to express the deep sorrow with which they viewed "the divided condition of the flock of Christ throughout the world," and to record their conviction that "unity will be most effectually promoted by maintaining the faith in its purity and integrity, as taught in the Holy Scriptures, held by the primitive Church, summed up by the creeds, and affirmed by the undisputed general councils; and by drawing each of us closer to our common Lord, by giving ourselves to much prayer and intercession, by the cultivation of a spirit of charity and a love of the Lord's appearing."

The Episcopal Church, while it receives the Holy Scriptures as the ultimate rule of faith, does not throw them open to the varying interpretations of every man's private judgment, but explains them by the aid of traditions which it believes to have come down through an unbroken line of teachers from the apostles themselves, by the creeds, and by the definitions of Christian doctrine made by the general councils. Candidates for baptism are required to confess their faith in the words of the Apostles' Creed—adults in person, and infants by their sponsors. Communicants must receive also the Nicene Creed, which contains the same teachings in a more expanded form. Nothing is required from laymen, beyond acceptance of the Prayer-book and a proper deference to the instructions of the clergy, who are believed to derive their doctrine and their right to teach by a succession from the apostles. The thirty-nine Articles of the Church of England (except the twenty-first, "of the power of Christian princes in relation to general councils") are still bound up with the American Prayer-book, with a separate title-page, however, but the practice of signing them has been laid aside since the Revolution. The clergy sign, instead, a general declaration that they "believe the Holy Scriptures of the Old and New Testament to be the Word of God, and to contain all things necessary to salvation"; and they "solemnly engage to conform to the doctrines and worship of the Protestant Episcopal Church in the United States." The mode in which the teachings of Holy Scriptures are ascertained has been already pointed out.

Thus the Protestant Episcopal Church in the U. S. would seem to be one of the most liberal and comprehensive of religious bodies. It *may* contain within itself (it is not, however, asserted that it *does*) those, on the one hand, who apparently differ from Roman Catholics in little more than in denying the pope's jurisdiction in countries which are or have been included in the British empire, infallibility, and Mariolatry; and, on the other, those who are to be distinguished from Presbyterians only by their acceptance of episcopacy and the Prayer-book. Within these possible limits there would appear to be ample scope for religious thought; and the great freedom of religious thought accounts for the schools of teaching which have long existed. As men incline toward authority on the one hand, or individual judgment on the other, they are said to be High Church or Low Church. The lines of thought, however, are not sharply drawn, and the schools melt into each other by imperceptible degrees. The principles laid down by the bishops at Lambeth (themselves men of every conceivable school of thought) have been long tested, and have been found sufficient to maintain the unity and harmony of the Church. As reaffirmed in 1888 and formulated in the Lambeth propositions for unity of Christendom, they offer to divided Protestantism a basis for reunion with the primitive, apostolic, Catholic Church which would eradicate divisions while permitting the liberty of thought and worship which true Catholicity requires. This basis for union—the same, with verbal variations, as that proposed by the House of Bishops of the American Church at the General Convention at Chicago, 1886—is as follows:

(*a*) The Holy Scriptures of the Old and New Testaments, as "containing all things necessary to salvation," and as being the rule and ultimate standard of faith.

(*b*) The Apostles' Creed as the baptismal symbol, and the Nicene Creed as the sufficient statement of the Christian faith.

(*c*) The two sacraments ordained by Christ himself—baptism and the supper of the Lord—ministered with unfailing use of Christ's words of institution, and of the elements ordained by him.

(*d*) The historic episcopate, locally adapted in the methods of its administration to the varying needs of the nations and peoples called of God into the unity of his Church.

See *The Lambeth Conferences of 1867, 1878, and 1888*, edited by Randall T. Davidson (1889), *Church Reunion Discussed on the Basis of the Lambeth Propositions of 1888* (reprinted from the *Church Review*, 1890), and Bishop Perry's *Accounts of the Second and Third Lambeth Conferences*, the one printed in 1879, the other in 1891.

The dioceses and missionary districts of the American Episcopal Church cover every portion of the territory of the U. S. There were, according to the statistical *Year Book* of the Church for 1900, fifty-nine dioceses and seventeen missionary jurisdictions or districts with eight foreign jurisdictions. The five dioceses of New York form a federate council. The three dioceses of Illinois are organized as a province. There are twelve missionary districts. There are three foreign missionary episcopates, viz.: Cape Palmas, Africa (west coast); Shanghai, China; Tokio, Japan. Missions, besides, exist in Greece, Mexico, Brazil, Cuba, and Haiti. A bishop has been consecrated for the Church in Haiti, and one was consecrated for Mexico, who subsequently resigned. The churches on the continent of Europe at Paris, Rome, Florence, Geneva, Nice, Dresden, and Lucerne are organized into a convocation. Eighty-four bishops are living, and in 1900 there were 4,863 clergy, 506 candidates for orders, and 6,667 parishes and missions. During the year 1900 there were 60,052 baptisms and 43,419 confirmations, and the total contributions for religious purposes amounted to $16,102,-467.52. There were 46,222 Sunday-school teachers and 430,901 pupils.

LITERATURE.—For the general history, consult Bishop W. S. Perry's *History of the American Episcopal Church, 1587–1883* (2 vols., 1885); Anderson, *History of the Church of England in the Colonies and Foreign Dependencies of the British Empire* (3 vols., 1846; 2d ed., rearranged and enlarged, 1856); Wilberforce, *History of the Protestant Episcopal Church of America* (1846); McConnell's *History of the American Episcopal Church from the Planting of the Colonies to the end of the Civil War* (1890); Hawkins, *Historical Notices of the Missions of the Church of England in the North American Colonies* (1845); Updike, *History of the Narragansett (R. I.) Church* (1847); Bolton, *History of the Protestant Episcopal Church in the County of Westchester* (1855). For original sources of information, see Bishop Perry's *Historical Collections of the American Colonial Church* (1871–78); Perry, *Journals of General Conventions, 1785–1835* (3 vols., 1874); Perry's *Historical Notes and Documents Illustrating the Organization of the Protestant Episcopal Church* (1874); Hawks and Perry, *Documentary History of the Church in Connecticut* (2 vols., 1863–64); *The Churchman's Year-book* (2 vols., 1870–71); *Connection of the Church of England with Early American Colonization* (1863); and *Historical Sketch of the Protestant Episcopal Church in the United States, 1784–1884* (1884); Bishop White, *Memoirs of the Protestant Episcopal Church in the United States* (1820; 2d ed. by Francis Lister Hawks, 1836; 3d ed. by Rev. Dr. B. F. De Costa, 1880); Beardsley's *History of the Episcopal Church in Connecticut* (2 vols., 1865; 4th ed. 1883); *Life and Correspondence of Samuel Johnson, D. D., Missionary in Connecticut and First President of Columbia College* (1874); and *Life and Correspondence of Bishop Seabury* (1881); Dalcho, *Historical Account of the Protestant Episcopal Church in South Carolina* (1820); Perry's *Handbook of the General Convention* (3d ed. 1880), and his ed. of Proctor *On the History of the Common Prayer* (1863–89); Hill's *History of the Church in Burlington* (1876; 2d ed., enlarged, 1885); Dorr's *History of Christ Church* (Philadelphia, 1856); Dr. J. B. Cheshire's *Church in the Province of North Carolina* (1890); and numerous monographs, etc. The legislation of the Church is embodied in the *Journals of the General Convention*, published triennially and oftener (1785–1892); the journals of the early and preliminary conventions (1785–1814) were edited by Bishop White (Philadelphia, 1814); those from 1785–1835 were published by authority of the General Convention, and edited by Bishop Perry in 3 vols., with notes, etc.

Revised by WILLIAM STEVENS PERRY.

Episcopal System: in the Roman Catholic Church, that theory according to which the highest clerical power is vested in the whole body of bishops. This theory was most prominently brought forward in the papal elections of the fourteenth century, and its followers declared the Church, as represented in its general assemblies, to be above the pope. In France the University of Paris was the chief supporter of this theory, and the Gallican Church accepted it as one of its fundamental laws. In Germany the coadjutant bishop of Treves, Nikolaus von Hontheim, who was one of its chief supporters, wrote under the pseudonym of Justinus Febronius a celebrated book, in which he clearly defined the episcopal system, *De statu ecclesiæ et legitima potestate Romani Pontificis* (Frankfort-on-the-Main, 1763). The Punctations of Ems (see EMS) had the same fundamental idea, and, although they failed in their purpose, the system continued to spread in Germany. But the declaration of papal infallibility has put an end to these differences, and made an impossibility of the episcopal system. In the German Protestant churches the episcopal system is that theory according to which the authority of the bishops, which had been suspended in the Protestant countries in consequence of the peace of 1555, was transferred to the ruler of the country.

Episco'pius, SIMON: a divine whose original name was *Bishop*, or *Biscop*; b. in Amsterdam, Holland, Jan. 1, 1583; studied at Leyden. He was distinguished for his liberality, moderation, and other virtues, and became the chief pillar and champion of the Arminians, or Remonstrants. He was appointed Professor of Theology in the University of Leyden in 1612, but he was accused of Socinianism by the Calvinists (Gomarists), and was banished in 1618 by the Synod of Dort. He retired to France, returned to Holland in 1626, and lived in Rotterdam, and became first Professor of Theology in the newly established Remonstrant Seminary in Amsterdam in 1634. His principal works are the *Confession of the Remonstrants* (1621) and *Institutiones Theologicæ*. His complete works appeared Amsterdam (2 vols., 1650–65). See his *Life* by F. Calder (London, 1835; New York, 1837). D. in Amsterdam, Apr. 4, 1643.

Episode [from Gr. ἐπεισόδιον, a parenthetic addition, in the Greek drama a dialogue introduced between the choral songs, neut. of ἐπεισόδιος, coming in besides; ἐπί, upon, in addition + εἴσοδος, entrance (εἰς, into + ὁδός, way)]: originally, one of those parts of an ancient classical drama which were performed between the entrances of the chorus. In modern use it signifies an incidental narrative or digression in the poem, more or less connected with the main plot, but not essential to its development.

Epis'tates [Gr. ἐπιστάτης, commander, president; ἐπί, upon + στῆναι, stand]: the title of the presidents of the two great councils of the ancient Athenians—viz., the Ecclesia and the senate of Five Hundred. Their term of office was one day.

Epistaxis [from Gr. ἐπιστάζειν, to bleed at the nose; ἐπί, upon + στάζειν, to drop]: the technical medical term for bleeding from the nose; a symptom traceable to various causes. It may be of slight importance, as very often in certain children who have repeated slight bleedings from the nose. In these there is no diseased condition discoverable. Again, it is of slight importance in persons in whom headache or confinement in a close room is apt to lead to bleeding, and indeed in such cases not rarely a measure of relief is afforded by the epistaxis. Besides these cases there are many serious diseases in which nosebleed occurs. Such are the various forms of diseases of the blood, purpura, and hæmophilia; diseases of the heart or kidneys in which the blood-vessels are apt to be diseased and congestions occur; and in whooping-cough during the paroxysms. Epistaxis is a symptom of considerable value as indicating the onset of typhoid fever, as it is very common during the first week, when the general symptoms are ambiguous. Bleeding from the nose as a result of injury, or in children from picking with the fingers, is easily recognized.

Generally the hæmorrhage soon stops of its own accord, but sometimes it requires treatment. Cold water, tannin, alum, and other agents may suffice. Pressure inward against the septum may prove efficacious. In more serious cases active medicinal agents may be required, or even firm packing of the cavity. Very rarely the bleeding is most obstinate, and in blood diseases, or less frequently other conditions, may be the immediate cause of death.

WILLIAM PEPPER.

Epistemology [from Gr. ἐπιστήμη, knowledge + λογία, deriv. of λόγος, discourse]: the theory of the grounds of knowledge or science. J. F. Ferrier, in his *Institutes of Metaphysics*, treats of Epistemology, or theory of knowing, Agnoiology, or theory of ignorance, and of Ontology, or theory of being. See EPISTEMOLOGY in the Appendix.

Epistle [from Lat. *epis'tola* = Gr. ἐπιστολή, message, command, deriv. of ἐπιστέλλειν, send to, enjoin upon; ἐπί, to, upon + στέλλειν, send]: literally, a thing *sent*, hence a letter. The name is now given especially to the twenty-one epistles of the New Testament. The writings ascribed to the so-called Apostolic Fathers (Clement of Rome, Barnabas, Ignatius, Polycarp, and Hermas) are for the most part epistolary in form. Of quite inferior dignity and value are the following undoubtedly spurious epistles: Abgarus of Edessa to Christ, and Christ to Abgarus; Lentulus to the Roman Senate; several of the Virgin Mary; Paul to the Laodiceans; the Third of Paul to the Corinthians, and one of the Corinthians to Paul; Peter to James; eight of Seneca the philosopher to Paul, and six of Paul to Seneca.

Epis'tolæ Obscuro'rum Viro'rum [Lat., letters of obscure men]: a famous collection of satirical letters directed against the monks and the Roman Catholic Church. They were published in three parts—the first at Haguenau (1515), the second at Basel (1517), and a third at a later date. They were probably written jointly by Ulrich von Hutten, Crotus Rubianus, and Buschius. They are an admirable imitation of the barbarous Latinity of the monks of those days. Certain Dominicans at Cologne, under the lead of one Pfefferkorn, a baptized Jew, advocated the expulsion of all Jews from Germany, the forcible education of their children in Christian doctrine, and the burning of their books. This attempt was opposed by Reuchlin, and pending the decision of the question by the pope the *Epistolæ* appeared. Says Sir William Hamilton: "The *Epistolæ* are at once the most cruel and most natural of satires, and as such they were the most effective. They converted the tragedy of Reuchlin's persecution into a farce; annihilated, in public estimation, the enemies of intellectual improvement; and even the friends of Luther, in Luther's lifetime, acknowledged that no other writings had contributed so powerfully to the downfall of the papal domination." Many editions of the *Epistolæ* have been published, the best of which is that of Boecking (Leipzig, 1858); German trans. by W. Binder (Stuttgart, 1876).

Epithala'mium [Lat. *epithala'mium*, from Gr. ἐπιθαλάμιος, -ον, at the door of bridal chamber, ὁ or ἡ ἐπιθαλάμιος (sc. ὕμνος or ᾠδή), song before door of bridal chamber; ἐπί, upon + θάλαμος, chamber]: a bridal hymn; a chorus sung, in ancient Greece, near the door of the bridal chamber. It appears to have been a formal part of the marriage ceremony. Among the ancient Romans the rude Fescennine songs, which seem to have been of a phallic character, were often sung at weddings, and are hence called epithalamia. The term is often given to formal poems composed in honor of a particular marriage. Anacreon and Pindar composed poems of this kind. The most perfect example of it now extant is the epithalamium of Peleus and Thetis, by Catullus.

Epithelio'ma [mod. deriv. by suffix *-ōma*, as in *carcinoma* = καρκίνωμα, cancer, from EPITHELIUM (*q. v.*)]: a variety of cancer which attacks most frequently the surfaces which are covered with pavement or cylindrical epithelium, constituting, in the former situation, flat-celled cancer; in the latter, cylindrical-celled. Many pathologists class the former with "cancroid" disease, because it appears to be less malignant than true cancer. Indeed, if removed early, the patient has a fair prospect of future exemption from the disease, but in neglected cases it assumes the malignancy and other dreadful characters of true cancer. The lips, especially the upper lip, are the most frequent seat of epithelioma, but it may attack even internal organs. Histologically, it is composed of epithelial elements. See CANCER. Revised by WILLIAM PEPPER.

Epithe'lium [Mod. Lat. from Gr. ἐπί, upon + θηλή, nipple, used in sense of Lat. *papilla*, pl. *papillae*, i. e. of the skin]: in anatomy, the layer of cells which line the mucous (or open) cavities of the body, the mucous epithelium being continuous with the epidermis, which is also a form of epithelium.

Epithelium is of various kinds, according to the shape of the cells, thus: squamous or flat cells, cylindrical cells, cuboidal cells, etc. A peculiar variety of cylindrical is the "ciliated epithelium," which is provided with fine hair-like processes (cilia), whose length varies from $\frac{1}{1000}$ to $\frac{1}{12000}$ of an inch. These cilia have a rapid automatic motion in one direction, moving from 150 to 250 times in a minute. These motions are no doubt highly important in physiology, but their mechanism is little understood. In some instances these motions obviously assist in discharging excretions, etc., but in others their use is quite unknown. The epithelial cells have a very important part in the secretion of many fluids. For example, mucus is formed by the bursting of epithelial cells and the discharge of their soft contents, mingled with the *débris* of the old cell-walls. This process of destruction is attended by continual renewal of the cells.
Revised by WILLIAM PEPPER.

Epithet [from Gr. ἐπίθετος, -ον, attributed; ἐπί, upon + θεῖναι, put]: a word or clause which expresses some attribute of an object that is prominent in thought, but is not made the basis of a discrimination or classification; e. g. "*Frail* man is mortal"; "Earthly pleasures, *which are fleeting and unsubstantial*, are not the highest for man." Used in opposition to definitive (from Lat. *definire*, to define, to mark out the *fines* or boundaries), by which we understand a word or clause which expresses some attribute that *is* made the basis of a discrimination or classification; e. g. "*Good* men [i. e. only good men] are a blessing to the community"; "Those pleasures *that are from the earth* are not the highest for man."

Great care should be taken that epithets be not too frequently employed, and that there be something in the thought to which they actually and exactly correspond. The felicitous employment of epithets is one of the attributes of genius which gives to literature its highest charm; as in Milton's

Drew iron tears down Pluto's cheek.

Epitome, ĕe-pit'ō-mēe [Gr. ἐπιτομή, abridgment, deriv. of ἐπιτέμνειν, cut into, abridge]: in literature, an abridgment; a work in which the contents of a former work are reduced into a smaller space by curtailment and condensation. In the declining age of the Western Roman empire the practice of epitomizing the works of older writers, especially in history, became very prevalent. In several instances a valuable original work has been lost which perhaps would have been preserved if an epitome had not been substituted for it. Among the best-known works of this class are the epitome of Florus, *Epitome Rerum Romanarum*, and that of Eutropius, *Breviarum Historiæ Romanæ*, both abridgments of the history of Rome.

Epitro'choid [from Gr. ἐπί, upon + τροχός, wheel + suffix *-oid* (-οειδης), having the appearance of]: a curve traced by a point in the plane of a circle which rolls on the convex side of a fixed circle. The curve thus generated is one of the family of roulettes, and becomes an epicycloid when the generating point is in the circumference of the rolling circle. When the two circles are equal the epitrochoid becomes similar to the pedal of the fixed circle with respect to a certain fixed point in its plane. But the pedal being always the inverse of the reciprocal of the primitive curve, the epitrochoid in this case must be the inverse of a conic with respect to one of its foci, which latter is a curve of the fourth order, belonging to the Cartesian ovals, and called the *limaçon*. Epitrochoids are generally transcendental curves; it is only when the circumferences of the fixed and rolling circles are commensurable that the epitrochoid returns into itself and becomes an algebraical curve.

Epizo'a [from Gr. ἐπί, upon + ζῷον, animal]: animals, mostly arthropods, which are parasitic upon other animals. The term is one which refers to habits, and has no systematic value. J. S. K.

Epizoöt'ic [from Gr. ἐπί, upon, to + ζῷον, animal, the prefix *epi* being used to give force of temporarily prevalent in distinction from *enzoötic*; cf. *epidemic* vs. *endemic* of diseases among human beings]: a disease which attacks the lower animals, or any one species of them, as epidemics attack men. The term is objectionable, because, with some limitations, these diseases chiefly attack but one species, instead of all animals; and, moreover, as man is an animal, all epidemics are epizoötics. The so-called epizoötic diseases follow the general laws of epidemics, as they seem to attack especially the domesticated animals. Some diseases attack both man and the lower animals. Thus smallpox affects the horse, cow, and sheep, assuming in each a modified form. Among the more important epizoötic diseases are the rinderpest, the contagious pleuro-pneumonia, and the "foot-and-mouth disease" (all attacking neat cattle); the remarkable influenza which attacked horses and mules, arising in Canada, Sept. 30, 1872, and rapidly moving southward and westward over the whole of North America; the scab, foot-rot, and other diseases of sheep. The "reds," the *muscardine*, *pébrine*, and other diseases of the silk-worm have been the cause of serious calamities to operatives, and at times have almost threatened the existence of the silk manufacture.

The epizoötic influenza of 1872–73, above alluded to, destroyed, according to Dr. A. B. Judson, of New York, 1,500 horses and mules in New York, or 4 per cent. of the total number in the city. The disease reached Chicago Oct. 29, St. Louis Dec. 1, Salt Lake Jan. 11, 1873, and San Francisco Apr. 15. It is thought that the disease spread chiefly by contagion, and not by atmospheric influence.

E Plu'ribus U'num [Lat., intended to mean one composed of many]: the motto of the U. S. After the Declaration of their independence had been announced by the States on July 4, 1776, and before the adjournment of that day's session, it was resolved, "That Dr. Franklin, Mr. J. Adams, and Mr. Jefferson be a committee to prepare a device for a seal for the United States of America." The result of their joint work was the present seal of the U. S., which has not been changed since its first adoption. The six sections, or quarterings, upon the escutcheon or shield were intended to denote the countries (England, Scotland, Ireland, France, Germany, and Holland) from which the States so united had been, respectively, chiefly peopled. The motto adopted on this seal, and retained ever since, was intended to denote the character of the federal government in its formation.

Epode [from Gr. ἐπῳδός, sung after]: in ancient prosody, 1, (ὁ ἐπῳδός) the shorter, usually the second, verse of a couplet, as an iambic trimeter and dimeter; hence a poem consisting of such couplets, as the *Epodes* of Horace. Though the Elegiac Distich (*q. v.*) is epodic, elegies are not usually called epodes. 2, (ἡ ἐπῳδός) in Greek poetry, a lyric system like a Strophe (*q. v.*), occurring after a pair of strophes (strophe and antistrophe), so that the three sometimes form a compound unit, called a *triad*. All the odes of Pindar, some lyric fragments, and some choric odes of the drama contain epodes. Milton W. Humphreys.

Epping: town of Essex, England; at the north end of Epping Forest; 16 miles N. N. E. of London (see map of England, ref. 12–J). It is noted for its cream, butter, and sausages. Epping Royal Forest, formerly Waltham Forest, covers 60,000 acres, but was once much more extensive, covering the whole of Essex almost to the very gates of London. Now only 13,000 acres are in woods and wastes, and the rest is inclosed as private property. It was formerly the seat of a famous fair held every year around Fairlop Oak, and of a stag-hunt held on Easter Monday. In the midst of the forest Queen Elizabeth's hunting lodge is still standing. Pop. 2,500.

Epsom: market-town of Surrey, England; 14 miles by railway S. S. W. of London (see map of England, ref. 12–J). It has mineral springs containing sulphate of magnesia, which derives from this place the name of Epsom salt. They were first discovered in 1618, and for some time drew great numbers of visitors to the town. Charles II. and Prince Jörgen, of Denmark, the spouse of Queen Anne, often resorted to them. Gradually, however, they were deserted. Epsom has a royal medical college, and is famous for its horse-races, which are held yearly on the Downs, $1\frac{1}{2}$ miles S. of the town. The races last four days, one of which is called Derby Day, and are more numerously attended than any other races in the kingdom. They were permanently established in 1730. Pop. (1891) 8,417.

Epsom Salt (in Lat. *magnesiæ sulphas*—i. e. sulphate of magnesium; Germ. *Schwefelsaure Magnesia*): the magnesium sulphate ($MgSO_4.7H_2O$), a salt, when pure, usually found in colorless acicular crystals derived from the right rhombic prism, and containing 51·22 per cent. of water of crystallization. It is somewhat efflorescent, for at 32° F. water will dissolve over one-fourth its weight of the anhydrous salt, and as the temperature is raised the solubility increases. The salt was formerly manufactured from the waters of the mineral spring of Epsom, England. It also exists largely in sea-water, from which it was formerly prepared in large quantities. In Italy it is prepared from a schistose rock; in England from dolomite; in Pennsylvania and Maryland from magnesite. This salt is used in medicine as a cooling and generally safe cathartic. The dose is from half an ounce to an ounce in a glass of water. It is nauseous to the taste, but may be easily taken in "soda-water," with lemon sirup. In the household it is an excellent addition to starch, decidedly increasing its stiffening powers. Mixed with ordinary whitewash, it gives a fine pearly whiteness to walls.

Epworth League: a voluntary organization composed of young people of the Methodist Episcopal Church; having for its object the promotion of piety in its members and their development along social, intellectual, and religious lines. It was organized at Cleveland, O., May 14 and 15, 1889, at a convention of the representatives of five general young people's societies of the Methodist Episcopal Church. Its headquarters are at Chicago, where also is published weekly *The Epworth Herald*, its official organ. The league has now (1901) 5,838 chapters and 306,580 members. It was officially adopted and indorsed by the General Conference at Omaha, May, 1892. The Methodist Church of Canada and the Methodist Episcopal Church South have adopted the Epworth League for their work among young people. See Christian Endeavor, Young People's Society of.

John F. Hurst.

Equation [from Lat. *æqua'tio*, a making equal]: in algebra, a statement that two quantities having different algebraic expressions are equal. The equality is expressed by writing the sign = between the expressions asserted to be equal. Each of the equal expressions is called a member of the equation. Equations are of two kinds—identical and conditional. An *identical* equation is one in which the two expressions must be equal from their very nature or meaning; as, for example, $3 + 3 = 6$ and $(a + b)^2 - 2ab = a^2 + b^2$. In either of these equations the two members are equal because they express the same quantity in different ways, and so remain equal whatever values we assign to the quantities. *Conditional* equations are those in which the two expressions are not equal for all values of the quantities, but which imply certain relations between them. For example, if we have the equation $x + y = 6$, this equation is not true from the nature of the case, nor is it true for all values of x and y. It is true only on condition that the quantities x and y are so chosen that their sum shall be 6. It is because of this that such equations are called conditional.

Equations, Theory of.—The theory of equations is that branch of algebra which treats of the equations called algebraic, namely, those which can be reduced to the form

$$x^n + ax^{n-1} + bx^{n-2} + cx^{n-3} + \text{etc.} = 0,$$

x being the unknown quantity, n a positive integer, and a, b, c, etc., any coefficients whatever which do not contain x. The roots of such an equation are those special values of x which, being substituted in the equation, will satisfy it by reducing the algebraic sum of its terms identically to zero.

The degree of an equation is the exponent, n, of the highest power of x. Equations of the second degree are called quadratic, of the third cubic, of the fourth quartic, or biquadratic, etc. The fundamental theorem of the subject is that the roots of every such equation are equal in number to the exponent, n, of the highest power of the unknown quantity which enters into it. But two or more of the roots may be equal.

The principles involved in such equations, the relations between their roots, and the possibility of expressing a root algebraically in terms of the coefficients, have been developed into a most extensive and interesting branch of mathematics. The solution of an algebraic equation consists in finding an expression for x which, being substituted in the equation, will satisfy it. The possibility of a solution will depend on the nature of the equation. One in which the coefficients of the powers of x, which we have called a, b, c, etc., are all separate and independent quantities, is called a *general equation*. General equations are classified according to their degree, as just defined. It was long since found that the general equations of the second, third, and fourth degrees admitted of being solved. But the equation of the fifth degree defied all the efforts of the mathematicians who attacked it. At length, early in the nineteenth century, it occurred to the illustrious Abel to inquire whether a solution was possible. By a profound analysis he succeeded in demonstrating the proposition that the solution of the general equation of the fifth degree was impossible;

that is to say, that no possible algebraic expression could be formed which, being substituted for x in the equation, would satisfy the latter. Thus the question is forever set at rest. But it is possible to write special equations of the fifth or higher degrees which admit of being solved. The conditions under which this may be done are now well understood, but belong to the highest branch of algebra. See SUBSTITUTIONS, THEORY OF.

The solution of equations of the third and fourth degree is effected as follows:

Solution of the Cubic Equation.—Let the equation be

$$x^3 + ax^2 + bx + c = 0. \qquad (1)$$

Replace x by a new quantity, x', thus:

$$x = x' - \tfrac{1}{3}a. \qquad (2)$$

By this substitution the second term of the equation will disappear, and the latter will be reduced to the form

$$x^3 + px + q = 0, \qquad (3)$$

p and q being simple functions of a, b, and c, and the accent being omitted from x'.

In this equation put for x the sum of two quantities, to be afterward determined:

$$x = y + z. \qquad (4)$$

We then have

$$(y + z)^3 + p(y + z) + q = 0,$$

or

$$y^3 + z^3 + (y + z)(3yz + p) + q = 0. \qquad (5)$$

Let us now determine the quantities y and z, so as to satisfy the condition

$$3yz + p = 0. \qquad (6)$$

We then have

$$z = -\frac{p}{3y}, \qquad (7)$$

and by substituting this value of z in (5)

$$y^6 + qy^3 - \frac{p^3}{27} = 0. \qquad (8)$$

This equation may be solved by quadratics, so as to give the value of y^3 from which z^3 is found by (7). Then extracting the cube roots we have the values of y and z, which, being substituted in (4), will give the value of x as follows:

$$x = \sqrt[3]{\frac{-q}{2} \pm \mathrm{R}} + \sqrt[3]{\frac{-q}{2} \mp \mathrm{R}},$$

where we put, for brevity,

$$\mathrm{R} = \frac{q^2}{4} + \frac{p^3}{27}.$$

Solution of the General Equation of the Fourth Degree, or Biquadratic Equation.—Let the equation be

$$x^4 + px^3 + qx^2 + rx + s = 0. \qquad (1)$$

We may reduce this equation to the form

$$(x^2 + \tfrac{1}{2}px)^2 = \left(\frac{p^2}{4} - q\right)x^2 - rx - s, \qquad (2)$$

which it will be seen is equivalent to the original one. We have now to add to both members of this equation such a quantity as shall make them perfect squares. In order that the first member may thus be made a perfect square, the quantity to be added must be in the form

$$2(x^2 + \tfrac{1}{2}px)y + y^2, \qquad (3)$$

which will make the first member a square, no matter what the value of y. We must afterward choose y so as to make the second member a perfect square. This member will become

$$\left(\frac{p^2}{4} - q + 2y\right)x^2 + (py - r)x + y^2 - s. \qquad (4)$$

Imagine this equation written in the form

$$\mathrm{A}x^2 + \mathrm{B}x + \mathrm{C} = 0. \qquad (5)$$

The condition that it shall be a perfect square is

$$\mathrm{B}^2 - 4\mathrm{AC} = 0. \qquad (6)$$

or

$$(py - r)^2 - 4\left(\frac{p^2}{4} - q + 2y\right)(y^2 - s) = 0.$$

This is a cubic equation in y, which can be solved by the method of cubic equations. With this value, the second member of (2), with the expression (3) added to it, will become a perfect square, while the first member will be the square of

$$x + \tfrac{1}{2}px + y,$$

and thus the equation will admit of solution.

The actual algebraic expressions which enter into the solution are too complicated to be written here.

S. NEWCOMB.

Equation of Time: the difference in mean solar time between the sun's apparent or true right ascension and its mean right ascension; or, in other words, the difference between sun time and clock time. This difference arises—(1) from the sun's unequal motion in longitude because of the eccentricity of the earth's orbit; (2) from the obliquity of the ecliptic; and (3) to some small extent from the perturbations of the moon and planets. Sun time and clock time agree about Dec. 25, Apr. 16, June 16, and Sept. 1. The equation of time is greatest about Nov. 1, when the clock is sixteen minutes and sixteen seconds faster than the sun. See TIME.

Equation, Personal: the constant which must be applied to every time observation recorded by an observer (as in astronomy) in order to make the mean of such observations agree with those of another observer. It is found by experience that different persons, in recording the results of observations, will make various errors, some anticipating the event, but others failing to record it at the proper time. When it is found possible, by examining a long series of records made of the same events by two observers, to discover the average difference between their records of events, a very important correction of time-intervals may sometimes be introduced into a computation based upon such records. Such a correction is called the relative personal equation of the two astronomers. When it is found that an observer habitually makes, or is likely to make, a certain error in his time-records, such error (or absolute personal equation) can be readily allowed for.

Equator [Lat., an equalizer, deriv. of *æqua're*, to make equal]: in geography, a great circle of the terrestrial sphere which is equidistant from the two poles, and divides the earth into northern and southern hemispheres. Latitudes are counted from the equator along the meridian, and longitudes are measured on the equator or on some circle parallel with it. See EARTH.

EQUATOR, in astronomy, is the great circle of the celestial sphere, of which the plane is perpendicular to the axis of the earth's diurnal motion. It is called the equator because when the sun is in its plane the days and nights are exactly equal all over the world. The equator divides the sphere into northern and southern hemispheres, and is often styled the *equinoctial*. The apparent diurnal motions of all the celestial bodies are performed in circles which are parallel to it. The right ascensions are measured on it.

Equatorial Telescope: a telescope mounted upon a fixed axis parallel to the axis of the earth, and turning also upon a second movable axis parallel to the equator, for the continuous observation of heavenly bodies, and for noting their right ascension and declination. The motion of the telescope round its fixed or "polar" axis is necessarily parallel to the equator, and this gives the instrument its name. In order to maintain the object observed steadily in the field of view, the telescope is made to revolve round the polar axis by an attached clockwork, which admits of being regulated so as to vary the volocity of rotation, according as the object under examination is the sun, the moon, a planet, or a fixed star.

Equestrian Order, also called **Knights**: an important division of the citizens of ancient Rome. They were originally a military organization, and formed the cavalry of the Roman army. According to Livy, Romulus constituted three centuries (300) of equites, to whom he gave the several names of Ramnenses, Titienses, and Luceres. Down to the year 123 B. C. the equites formed simply a division of the army, and their centuries were composed of patricians and plebeians, but C. Gracchus in that year procured the passage of the *Lex Sempronia*, which instituted a new class or political order called *ordo equestris*, from whom all the *judices* (judges) must be selected. The reform of Sulla deprived them of the sole right of being chosen as judices, who thenceforth were selected from the senators, equites, and *tribuni ærarii*. The equites also enjoyed the privilege of officiating as *publicani* or farmers of the public revenue. According to Cicero, who belonged to this order, these publicani "comprised the flower of the Roman chivalry, the ornament of Rome, the firm support (*firmamentum*) of the republic." The badges of the equites were a gold ring and a robe with a narrow purple border.

Equestrian Statue: a complete figure of a person on horseback, executed generally in bronze or stone. In ancient Greece, where plastic art attained its highest perfection, statues of men and horses were often of the first excellence; but horses were more commonly represented as attached to the chariot. In Rome, equestrian statues of the emperors were common. The finest extant Roman work of the kind is a bronze equestrian statue of M. Aurelius Antoninus. Two remarkable statues of this kind have come down to us from the time of the Renaissance—that of Bartolomeo Colleoni at Venice, by Verrocchio and Leopardi, and that of Gatamelata, at Padua, by Donatello. Among the famous modern equestrian works are the noble colossal statue of Peter the Great at St. Petersburg, and that of Frederick the Great at Berlin, by Rauch.

Eq'uidæ [from Lat. *e'quus*, horse]: the family of which the genus *Equus* (including the horse, ass, etc.) is a type, and which is a section (*Solidungula*) of the order *Ungulata*. The most characteristic feature of the *Equidæ* is the solid, one-toed foot formed by the union of the central phalanges and the atrophy of the lateral ones. Single-toed horses began in the Pliocene. In the Miocene epoch horses were represented by *Hipparion*, etc., which had two small lateral toes or hoofs, of which some traces may be often found in living horses. In the Lower Miocene *Anchitherium* represents the *Equidæ*, and connects the horse with *Palæotherium*, *Pliolophus*, etc., of the Eocene and with the tapirs of the present day. The genealogy of the *Equidæ* is better known and more instructive than that of any other group of mammals. Nearly twenty species of equine quadrupeds have been described from the Tertiary and Quaternary deposits of America, but it is supposed that no horse existed in the New World at the time of the advent of the Europeans. See HORSE and HIPPARION.

Equilateral [from Lat. *æ'quus*, equal + *latus*, *-eris*, side]: having equal sides. In geometry, a rectilinear figure is said to be equilateral when all its sides are equal. If, moreover, its angles are all equal, it is called *regular*. Every equilateral figure inscribed in a circle is equiangular, and therefore regular. The converse theorem, however, is true only for polygons with an odd number of sides. An equilateral hyperbola is that of which the axes are equal.

Equilibrium [Lat. *æquili'brium*; *æquus*, even + *libra*, scale]: the state of rest produced by two or more mutually counteracting forces; equipoise. Equilibrium is the foundation of the theory of mechanics; it is, in its generalized meaning, *the physical law of the universe*. EQUILIBRIUM, in the fine arts, is the just place or balance of a figure or other object, so that it may appear to stand firmly. Also the due equipoise of objects, lights, shadows, etc., against each other.

Equinoctial: See EQUINOX.

Equinoctial Points: the two opposite points of the celestial sphere in which the ecliptic and equator intersect each other, the one being the first point of Aries, and the other the first point of Libra. These points do not retain a fixed position in relation to the stars, but retrograde from E. to W. with a slow motion, requiring 25,000 years to accomplish a complete revolution. This motion is called the PRECESSION OF THE EQUINOXES (*q. v.*).

Equinox [from O. Fr. *equinoxe* < Lat. *æquinoc'tium*; *æquus*, equal + *nox*, night]: in astronomy, the time when the sun passes through the equator in one of the equinoctial points. When the sun is in the equator the days and nights are equal all over the world, hence the derivation of the term. This happens twice every year—viz., about Mar. 21 and Sept. 22; the former is called the *vernal*, and the latter the *autumnal* equinox. The equinoxes do not divide the year into portions of equal length, but the interval from the vernal to the autumnal equinox is greater than that from the autumnal to the vernal; in other words, the sun continues longer on the northern than on the southern side of the equator, because it is more distant from the earth in our summer than in winter, and its angular motion in its orbit is consequently slower between March and September than in the other part of the year. In 1800 the difference amounted to seven days, sixteen hours and fifty-one minutes.

Equiseta'ceæ [from EQUISETUM (*q. v.*), the only genus]: a family of cryptogamous plants, with hollow and jointed stems, growing in ditches, wet ground, and rivers in many parts of the world. They are related to the ferns and the extinct Calamites. They are found fossil in coal, and were in ancient geologic periods very much larger and more numerous than at present. This family is now the sole representative of the single surviving order (*Equisetaceæ*) of the class *Equisetinæ*, the lowest class of the great division of the vegetable kingdom known as the fernworts (*Pteridophyta*). See FERNWORTS and PLANTS, FOSSIL.

Revised by CHARLES E. BESSEY.

Equise'tum [Lat. *equisetum*, the horsetail; *equus*, horse + *sæta*, *sēta*, bristles, coarse hair]: a genus of plants of the family *Equisetaceæ*, comprising numerous species called horsetail. The fructification is in the form of a spore-bearing cone at the summit of the stem. The *Equisetum hyemale* (scouring rush) is indigenous in the U. S. and also in Europe. The abundant silica in its cuticle renders it useful for polishing furniture and for scouring utensils. The U. S. have also several other species. True Equiseta date back to the Triassic, when they were numerous, and attained the height of 20 feet. In the Carboniferous rocks the Equiseta are represented by *Equisetites*, as well as by the related *Calamites*, *Calamodendron*, etc. Revised by CHARLES E. BESSEY.

Equites: See EQUESTRIAN ORDER.

Equity [from Lat. *æ'quitas*, equality, fairness; deriv. of *æquus*, even]: a portion of the mass of English jurisprudence, derived from the decisions of courts and the rules of approved text-writers. It originated in the same general way as that branch of jurisprudence technically called "common law." It is, in a sense, common law itself when considered in contrast with statutes. The relation of equity to common law can be best understood by a brief historical survey. After the Norman conquest of England the king was deemed to be the fountain of justice. Ultimately, certain great courts of general jurisdiction came into active operation, known as "king's courts." These were the common pleas, the king's bench, and the exchequer. At first, their functions were quite distinct, but in course of time, by fictions of law, jurisdiction was assumed, so that in some respects it became concurrent in these tribunals. The regular mode of bringing a question before one of these courts for adjudication was by an action, in which there was a plaintiff and a defendant. A formal statement of the plaintiff's claim and of the defendant's defense was made in written allegations termed pleadings, and the question thus raised was called the issue. A judge and jury disposed of issues of fact. The action must be commenced by a so-called *writ*, purporting to emanate from the king and addressed to the sheriff, who caused the defendant to be brought before the court. There was an office in chancery, from which the writs issued. They were framed in a technical manner. The clerks would only grant a writ when they could find a precise precedent in their office. Actions were real, personal, or mixed. A real action was adapted to the recovery of land; personal actions were used to recover money; and the two were combined in a mixed action. The personal actions were framed on the theory either of contract or wrong (technically called tort). Originally, they were debt, covenant, and detinue in cases of contract; and in case of tort, trespass, trover, and replevin. The object of the action of debt was to recover a specific sum of money due to the plaintiff. The action of covenant was brought upon an instrument under seal. "Detinue" was resorted to in order to recover a specific chattel which the defendant had received as a bailee. The action of trespass was instituted for an immediate and direct injury to person or property; trover was the appropriate means to recover the value of personal property wrongfully converted by the defendant; while replevin was used to recover the property itself.

It was found at an early day that the personal actions were quite insufficient to give full relief. A statute was enacted in 13 Edw. I. (ch. 24) which led to the introduction of a new form of action, termed "trespass on the case." This was a comprehensive name for all actions for wrongs where the injury was indirect and consequential, as in the case of negligence. It also included many cases now recognized as strictly actions upon contract, and called "assumpsit." If this statute had been wisely interpreted, no court of equity would have been necessary, nor would any probably have arisen. But the judges of the so-called common-law courts adopted very strict and narrow rules of construction, and confined the remedy under the statute to the same kind of relief as had been already recognized. All the relief granted in these courts may be summed up in a single phrase: one can recover money only or specific real or personal property. As society advanced in wealth and civilization, such a system of remedial justice was lamentably imperfect. Out of its imperfection grew the jurisdiction of courts of equity. The residuum of justice not granted to the common-law courts remained in the king. It became a practice to address petitions to him in particular cases for relief, which those courts could not grant. These were referred to the privy council, a powerful body of men selected by the monarch for their wealth or capacity. In process of time the disposal of these petitions devolved upon one of their number, the lord chancellor, who was a great officer, and who had usually the legal training which would fit him to dispose of the important questions submitted to him. Such matters were not presented by writ, as in the common-law courts, but by an application in the nature of a petition; and this commonly closed with the stereotyped phrase that the petitioner, having no sufficient remedy at common law, asked for relief "for the love of God and in the way of charity." At an early day the chancellor devised a writ, called a writ of subpœna, whereby a party to a suit could be compelled to disclose upon his oath facts bearing upon the controversy between him and the opposite party. This is called "discovery." No such power inhered in common-law courts. In this way the court of chancery became a regular tribunal for the administration of justice. It followed precedent, and has worked out a scientific system of equity jurisprudence. It has now become so bound down by rules that new principles can be introduced only by legislation. This point is treated in a masterly manner by Maine in his work on *Ancient Law*. It should be remarked that other courts besides the court of chancery acquired equity jurisdiction. Thus the court of exchequer had until modern times equity powers. There may thus be courts of *equity* which are not strictly courts of *chancery*.

When English jurisprudence had assumed a precise and fixed character, there were thus two sets of tribunals, called respectively courts of common law and courts of equity. In some cases the jurisdiction of the two courts was concurrent; in others the equity court had exclusive authority, as in the case of trusts. The courts differed in three principal respects; two of these were in matters of procedure, while the third distinction was radical and substantial. They differed as to the mode of proof and of trial, and in respect to the nature of the relief granted. The first two distinctions have been largely modified in the U. S. in a considerable number of the States. In these law and equity are administered by a single court and under the same system of pleading, so that there is no distinction between an action at law and a suit in equity. Even in these States the difference in relief still continues. When the action is for the recovery of money only, or of specific real or personal property, a writ issues to the sheriff to carry the judgment into effect. In other (or equity) actions, as when a defendant is required to execute or cancel a written instrument, or to refrain from doing an act, the order of the court is directed to him; and if he willfully disobeys it, he may be punished for contempt of court. This consolidation of law and equity was first attempted in a code of procedure adopted in New York in 1848. This has been substantially enacted in a number of other States, and has had much effect upon legal opinion in England. Courts of equity have adopted certain maxims which have had a large influence on the development of the system. They are such as these: (1) Equity follows the law; (2) He who comes into equity must come with clean hands; (3) He who asks equity must do equity; (4) Where the equities are equal, the legal title must prevail; (5) Equality is equity; (6) Equity regards that as done which ought to be done.

A brief exposition of a few of these maxims will show the principles which guide the action of the court. The maxim that "he who comes into equity must come with clean hands" does not refer to general moral delinquency. It only applies to the subject before the court. It then assumes a comprehensive meaning. Under it the court would not protect the copyright of an immoral book, or a trademark which was so used as to deceive the public. The maxim that "he who asks equity must do equity" means that the court will grant relief to a plaintiff only upon the condition that he will render justice to the defendant. For example, a borrower could not succeed in setting aside an instrument on the ground of usury, except upon the condition of paying to the creditor the debt and lawful interest. The maxim that "where the equities are equal, the legal title must prevail," means that the court will not, on the application of a plaintiff, deprive a defendant, being a purchaser for a valuable consideration, of a title recognized in a court of common law, unless he has acted in bad faith or with notice of the existing rights of the plaintiff. An illustration will show its application. If A has taken an informal mortgage upon land, and accordingly one not valid in law, and yet a good claim in equity, and B, without notice of A's rights, has taken for a valuable consideration a subsequent regular or formal mortgage or conveyance, B will have superior legal rights, which will be recognized in a court of equity. If B had acted with notice of the informal mortgage, A's equity would have been superior. The rule that "equality is equity" is applied to persons who ought to bear a common burden equally, as in case of the duty of co-sureties to contribute equally to pay the debt for which they are bound, or in cases of general average in the law of shipping. It is the principle which underlies the distribution of assets among creditors in cases of bankruptcy, or in the administration of the estates of intestates. The rule that "equity regards that as done which ought to be done" is one of great importance. It leads to a doctrine peculiar to this court, known as "equitable conversion." This phrase means that the owner of property, by the mere expression of his will according to legal rules, can change its legal character, and thus give to money the qualities of land, or to land those of money. Thus if a testator orders his land to be sold and converted into money, the land from the moment of his death is deemed to be personal property. The same result would follow if he had directed money to be laid out in land. So, if an owner of land contracts to sell it, his interest before any conveyance is made is deemed to be money, while that of the purchaser is regarded as land. This doctrine is attended with important practical consequences, to which the limits of this article do not permit a reference.

It is an important rule that the jurisdiction of this court attaches to the person of a litigant, without reference to the situation of the property in controversy. Thus the court of chancery in England might order a defendant within its jurisdiction to execute a conveyance of land situated in the U. S. It would proceed upon the theory that he was under a legal duty or obligation to do the act which as a matter of conscience he was bound to perform. The court was at one time termed a "court of conscience," and in the older law digests or abridgments the equity law is placed under that head. It should be added that mere gratuitous executory promises are not enforceable in this court. Attention is only paid to the claims of purchasers for a valuable consideration.

The topics of equity jurisprudence are usually considered by text-writers in their relations to the jurisdiction of the courts of common law. In this aspect equity jurisdiction may be regarded either as auxiliary to the jurisdiction of those courts, or as concurrent or exclusive. This method is necessarily discarded in those States where law and equity are administered under a uniform system of pleading and practice, as in New York. The principal subjects may be enumerated under the following heads: Cases of accident or mistake (as where a clause is omitted from an instrument by accident); cases of fraud, either actual or constructive; specific performance of contracts (e. g. requiring a party who has promised to execute a conveyance to fulfill his contract); cases of interpleader, whereby a mere stakeholder can be relieved from the results of a litigation; cases of accounts, including a variety of instances; cases of trusts, whether created by express words or arising from implication of law. The court also protects all persons under actual or legal disability, such as infants, married women, and persons of unsound mind. Under these and other heads the court may cancel, modify, or reinstate instruments, and in general adjust the rights of the respective parties to the controversy. In some of these cases actions may be brought in a court of law. Thus in case of fraud, if the injured party desired pecuniary damages, he would bring his action at law; if he desired to set an instrument aside, he would proceed in equity. A person who would have a good defense on the ground of fraud to an action at law may in some instances become plaintiff in equity, and have the instrument canceled, as in the case of a negotiable promissory note. The most extensive of all of these topics is the subject of trusts. Strict trusts are solely cognizable in this court.

The remedies in this court are flexible and readily adapted to the exigencies of the case. The most liberal rules prevail as to parties. Every person can be made a party whose presence is necessary to a complete determination of the matter in controversy. The court has power to prevent apprehended injuries to property by means of an injunction, or to place the property itself in the possession of one of its own officers, termed a receiver, until the rights of the parties are finally established.

The tendency of modern times would seem to be to blend the two systems of common law and equity jurisprudence into one, when the common law will prevail as *modified* by the rules of equity. T. W. Dwight.

Equity of Redemption: the right which the owner of mortgaged property has to redeem it after the condition of the mortgage has been broken. A mortgage is in form a conveyance of property, with a provision that it shall be void on the performance by the maker, within a given time, of a certain condition, usually the payment of a sum of money; and by the common law, if the condition is not performed the conveyance becomes absolute, and the maker of the mortgage, called the mortgagor, loses all right to the property. But the English court of chancery, an equity tribunal, as early as the reign of Charles I. asserted its power to remedy this hardship by compelling the mortgagee to give up the land on payment of the debt with interest. This right in equity to redeem the property after the conveyance has become absolute at law has in modern times come to be regarded as an estate in the land, and can be conveyed or mortgaged or devised by its owner. It passes by descent to his heirs; it is liable for the debts of his creditors, and can be sold on execution against him, and is subject to dower and curtesy. This right to redeem lasts till cut off by foreclosure of the mortgage, which is usually effected by an action in a court of equity. The foreclosure may result in giving a complete title to the mortgagee (called a *strict* foreclosure), or it may result in a sale of the premises and the payment of the debt out of the proceeds, the surplus being returned to the mortgagor or to those who claim under him. The right to redeem from the mortgage extends to all who acquire an interest in the land under the mortgagor after the making of the mortgage; and all such persons must be made parties to a proceeding to foreclose the mortgage, otherwise their right to redeem will not be affected. Formerly, unless restrained by some clause in the mortgage, the mortgagee could at once take possession of the premises, although equity compelled him to account for the rents and profits upon redemption. Now, however, the mortgagor has in general the right of possession till the condition is broken, and in some parts of the U. S. till foreclosure, except when after default, where the security is inadequate, a receiver is appointed to take charge of the property under the direction of the court. T. W. Dwight.

Equus: the typical genus of the family Equidæ (*q. v.*).

Era, Christian: See Christian Era.

Era of Martyrs: See Diocletian Era.

Érard, *ā*'raar', Sébastien: an inventor and maker of musical instruments; b. in Strassburg, Apr. 5, 1752; son of a poor cabinet-maker. His first pianoforte, constructed in 1780, may be said to have introduced that instrument into France. He soon became the best pianoforte manufacturer in Europe, and in connection with his brother established a manufactory in London. To Érard the piano owes some of its noblest qualities as a musical instrument. The grand piano, with single and double action, was his invention. He built the great organ for the royal chapel of the Tuileries. Érard was also the inventor of a double-action harp which had immense popularity in London, and took out patents for many other improvements, all of which were of value. D. near Paris, 1831. See Pianoforte.

Erasis'tratus (in Gr. Ἐρασίστρατος): a Greek physician and anatomist; supposed to have been a native of the island of Ceos. He flourished about 300–260 b. c., and practiced for many years at Alexandria, where he taught anatomy and founded a school. His principal discoveries were those of the *viæ lacteæ* and the functions of the brain and nerves. A few fragments of his works are extant. See Surgery.

Erasmus, Desiderius: scholar and philosopher; b. at Rotterdam, Holland, Oct. 27–8, 1467 (or 1466). He was a son of Gerard de Praet of Tergouw and Margaret of Zevenbergen in Brabant, who were married all but in name, and was called in his childhood Geert Geerts (i. e. Geert's or Gerard's son), which name he exchanged for the Latin and Greek equivalents of Gerard, each signifying "the well-beloved." He attended from his ninth to his thirteenth year the school of the Brethren of the Common Life at Deventer, where he was a pupil of Alexander Hegius. Having become an orphan about 1478, he was urged by his guardians to enter a monastery, in order that they might defraud him of his patrimony. Although he regarded a monastic life with aversion, he was at length induced in 1482 or 1483 to enter the Augustinian convent of Steyn by the hope that he might there have opportunity for study. He pursued the study of the classics and distinguished himself as a Latin scholar. He became in 1492 a priest and secretary to the Bishop of Cambray, with whom he remained nearly five years, and in 1496 went to Paris, probably for the purpose of completing his education. He was then nearly destitute of pecuniary resources, and gained a subsistence in Paris by teaching school. Between 1498 and 1500 he passed about two years in England, where he formed friendships with Sir Thomas More and John Colet. He resided at both the universities, and during his third and longest visit (1511–14) was Professor of Greek at Cambridge. Impelled by a strong passion for travel, he visited various countries of Europe, and never remained long in one place. In 1506 he commenced a tour in Italy, where he passed several years, perfected his knowledge of the Greek language, and associated with the most eminent scholars. He obtained from the pope a dispensation from his monastic dress, and received the degree of D. D. at Turin in 1506. Ten years later he was absolved from his monastic vows. In 1511 he published *The Praise of Folly* (Encomium Moriæ), a witty satire, in which he exposed the follies and foibles of monks, priests, and men of various other professions. It was generally admired and obtained a large circulation (modern Eng. trans. London, 1878).

Having established his reputation as the most eminent scholar and the most witty writer of his time, he received invitations from several monarchs, and in 1514 visited the court of the Archduke Charles of Austria (afterward Charles V.), who gave him the title of royal councilor, with a pension of 400 florins, and liberty to travel or reside wherever he might prefer. He produced in 1516 a good edition of the Greek New Testament—the first edition ever published—with a corrected Latin version and notes. He was on friendly terms with Luther in the first stage of the Reformation, which he efficiently promoted by his witty satires against the monks and priests, and by his censure of the corruptions of the Church of Rome. But he disliked dogmatism, was too liberal and moderate to please the zealous supporters of either side in a religious controversy, and he dissented from some of the doctrines of Luther, who denounced him in severe terms as a coward and time-server.

Erasmus became a resident of Basel about the year 1521, and published there in 1524 his celebrated *Colloquia* (Colloquies; Eng. trans., 2 vols., London, 1878), which some consider his capital work. It is ostensibly intended for the instruction of youth in Latin and morals, but abounds in satire and invective directed against the monks and the abuses of the Roman Church. It is stated that 24,000 copies of it were sold in one year. He was involved in a dispute with Luther on the doctrine of free will in 1524, and wrote on that subject *De Libero Arbitrio* (1526). He was condemned as a heretic by the Sorbonne of Paris, but he persisted in maintaining the attitude of a neutral or mediator, and never formally revolted against the pope. In 1529 he removed to Freiburg, where he passed several years. He died, when on a visit in Basel, on July 12, 1536. Among his works is *Adagia* (Venice, 1508; Eng. trans., 2 vols., London, 1814), a collection of proverbs, which displays immense learning. He greatly excelled as an editor of the Greek and Latin classics, for which he was qualified by superior critical sagacity as well as accurate scholarship. He was pre-eminent as a restorer of classical learning and sound philosophy. His voluminous *Epistles* contain valuable materials for literary history. His complete works were published by Beatus Rhenanus (9 vols., 1541), and best by Leclerc (10 vols., Leyden, 1603–06). See his *Life* by R. B. Drummond (2 vols., London, 1873).

Revised by S. M. Jackson.

Erastians: a name originally applied to a distinct party in the Westminster Assembly (*q. v.*), headed by Selden, Lightfoot, Coleman, and Whitelocke, because they advocated the views of THOMAS ERASTUS (*q. v.*) with regard to church discipline. During the conflict in the Church of Scotland, which led to the establishment in 1843 of the Free Church, those who maintained that the Church had no power to nullify by law the operation of lay patronage were called by their opponents Erastians, but they protested against this use of the word. See R. I. Wilberforce, *A Sketch of the History of Erastianism* (London, 1857).

Revised by S. M. JACKSON.

Erastus, THOMAS, M. D.: physician and theologian, whose proper name was LIEBLER or LIEBER, which he Græcized; b. at Baden in Switzerland (according to others at Auggen, near Badenweiler, Germany), Sept. 7, 1524. He studied theology at Basel, philosophy and medicine at Bologna and Padua, became body physician to the Elector Palatine Otto Heinrich, and Professor of Medicine at Heidelberg 1558; Professor of Medicine at Basel in 1580, to which branch he added ethics in 1583. He wrote several medical treatises and was a skillful practitioner. As a natural philosopher, he opposed the alchemists and the school of Paracelsus, but defended the burning of witches. As a member of the Sacramentarian conferences held at Heidelberg in 1560 and at Maulbronn in 1564, he vindicated the Zwinglian doctrine of the Lord's Supper, and in 1568 he circulated in manuscript some theses opposing the use by Protestant churches of ecclesiastical censures and punishments, and insisting that the Church ought merely to decide who, on account of soundness of faith, were to be regarded as members, but should not take upon herself to punish moral offenses by withholding her privileges. He was unjustly charged with Socinianism and excommunicated (1570), and was not restored till 1575. His opinions were developed in a volume printed six years after his death, entitled *Explicatio Gravissimæ quæstionis utrum excommunicatio . . . mandato nitatur divino an excogitata sit ab hominibus* (Pesclav, Switzerland [really London], 1589; English translation, *The Nullity of Church Censures*, London, 1659; new ed. by R. Lee, *The Theses of Erastus touching Excommunication*, 1844). To it Beza replied in his *De Vera Excommunicatione et Christiano Presbyterio* (Geneva, 1590). Erastus died at Basel, Dec. 31, 1583. S. M. J.

Erato: See MUSES.

Eratos'thenes (in Gr. Ἐρατοσθένης): Greek astronomer and geometer, and the first scholar to bear the name philologian; b. at Cyrene in 276 B. C.; a pupil of Callimachus the poet. He became superintendent of the great library of Alexandria in the reign of Ptolemy Euergetes, and rendered important services to the sciences of astronomy and geography. He displayed great versatility of genius, and wrote numerous works on philosophy, history, grammar, etc. Among his memorable performances was the measurement of the obliquity of the ecliptic, which he computed to be 23° 51′ 20″. In an attempt to ascertain the dimensions of the earth he invented a method which has been employed with success in modern times. His writings are not extant, but fragments of his work on chronology have been preserved by Syncellus (published by Bernhardy, 1822). "Eratosthenes was," says Bunsen, "next to Aristotle, the most illustrious of Greek men of learning, and as far superior to him in the extent of his knowledge as inferior in grasp of intellect." D. about 196 B. C.

Erben, HENRY: See the Appendix.

Er'bium [from *Ytterby*, a town of Sweden, whence gadolinite is procured]: a rare dyad earth-metal, chiefly procured, as an oxide called *erbia*, from gadolinite, along with yttria, both earths existing naturally as silicates. Metallic erbium (symbol E; atomic weight, 112·6) has not been separated. Its salts have mostly a rose color.

Ercilla y Zuñiga, ăr-thēēl'yăă-ee-thoon-yee'găă, ALONSO: epic poet; b. in Madrid, Aug. 7, 1533; a son of Fortunio Garcia, lord of Ercilla. He was in his youth a page of Philip II., whom he accompanied on a voyage to England in 1554. Having enlisted in the army, he went to South America in that year to fight against the Araucanians, a warlike tribe whom the Spaniards were never able to subjugate. He served with distinction in this war, returned to Spain in 1562, and published his *Araucana* (first part, 1569), which is considered the best heroic poem in the Spanish language, and is said to be a faithful narrative of the events which he had witnessed. He was afterward a gentleman of the bedchamber to the Emperor Rudolph II., but appears to have passed his latter years in poverty and obscurity. D. in Madrid, Nov. 29, 1594. See Ticknor, *History of Spanish Literature*.

Erckmann-Chatrian, ărk'măăn-shăă'tri-ăăn': the names of two French novelists whose works for many years were jointly produced, and whose names, like those of Beaumont and Fletcher, are inseparably united. ÉMILE ERCKMANN, b. at Pfalzburg, May 20, 1822, was the son of a bookseller, and after studying at the college of Pfalzburg applied himself to reading law in Paris. ALEXANDRE CHATRIAN, b. at Soldatenthal, near Pfalzburg, Dec. 18, 1826, was an usher in the Pfalzburg College when he made the acquaintance of Erckmann in 1847. The two became fast friends, and composed numerous stories, *feuilletons*, and dramatic pieces without much success. Unable to live in this way, Erckmann applied himself to the law, while Chatrian found employment in a railway office. *L'Illustre Docteur Mathéus* (1859) was the first of their writings which attained any popularity; it was followed by *Contes fantastiques* (1860); *Madame Thérèse* (1863), etc. Their novels upon the events of the Revolution and the first empire, *Histoire d'un conscrit de 1813* (1864), *L'Invasion* (1865), etc., were much read, and after the German annexation of Alsace they produced a novel under the title of *Histoire du plébiscite racontée par un des 7,500,000 oui* (1872), which made a sensation. Also their dramas, *Le Juif Polonais* (1869) and *L'Ami Fritz* (1876), though only dramatizations of novels, were very successful. Their literary partnership came to an end in 1889, when a quarrel and lawsuit terminated their friendship. Chatrian died in Villemomble, Sept. 4, 1890; Erckmann in Berlin, Mar. 14, 1899.

Erdmann, ărt'măăn, JOHANN EDUARD: philosopher; b. at Wolmar, Livonia, June 13, 1805; studied at Dorpat and Berlin; became Professor of Philosophy at Halle in 1836. He wrote, among other works, *Versuch einer wissenschaftlichen Darstellung der Geschichte der neueren Philosophie* (3 vols., Leipzig, 1834–53); *Grundriss der Logik und Metaphysik* (Halle, 1841; 4th ed. 1864); and *Grundriss der Geschichte der Philosophie* (2 vols., Berlin, 1866; Eng. trans. ed. by W. S. Hough, 3 vols., London, 1890; 2d ed. 1893). D. at Halle, June 12, 1892.

Er'ebus [Gr. ἔρεβος, darkness : Sanskr. *rajas* : Goth. *riqiz-*]: in classic mythology, the son of Chaos; also a dark and gloomy region or subterranean cavern through which souls were supposed to pass after death.

Erebus, Mount, and **Mount Terror**: two volcanoes in South Victoria Land, in lat. 77½° S., discovered by J. C. Ross Jan. 27, 1841. Mt. Erebus, 12,400 feet high, is, as far as is known, the volcano nearest to the south pole, and when discovered was emitting flame and smoke. Mt. Terror, 10,900 feet high, is believed to be an extinct volcano. These two mountains were named from the British ships in which Ross's expedition sailed.

Erechthe'um (in Gr. Ἐρέχθειον): in ancient Athens a sacred edifice on the Acropolis, containing the temple of Athena Polias and several other shrines. Its name was derived from ERECHTHEUS (*q. v.*), and a part of it is thought to be the "house" or shrine of that hero. It was burned by the Persians, rebuilt about 393 B. C., and became the most sacred of all the Athenian sanctuaries. The renewed Erechtheum was a most beautiful structure of the Ionic order. Unlike other Grecian temples, it had three porticoes—one to the east and occupying the whole width of the main structure, the other two facing the north and south, somewhat like the transepts of a Mediæval church. How the west end was finished is not well understood. It anciently contained a salt-well made by Poseidon's trident, also the sacred olive-tree of Athena, and the olive-wood image of that goddess, which is fabled to have fallen from the sky. The ruins of the Erechtheum stand north of the Parthenon, and are among the most interesting relics of antiquity. The six caryatides (female figures, larger than life, gracefully draped and carrying capitals upon their heads) which supported the roof of the southern portico are particularly fine. One of these is in the British Museum, and its place is filled by a terra cotta copy.

Erech'theus (in Gr. Ἐρεχθεύς; Fr. *Érecthée*): a hero of ancient Greek legends; said to be a son of Vulcan or of Pandion, and the father of Cecrops. Homer represents him as a king of Athens. According to tradition, he was the founder of the Erechtheum, a temple of Minerva on the Acropolis of Athens. He was sometimes called *Erichthonius*.

Eremacausis: See FERMENTATION.

Ere'tria (in Gr. Ἐρέτρια; Fr. *Érétrie*): an ancient city on the island of Eubœa mentioned by Homer (*Iliad*, book ii.). At an early period it was a prosperous and independent state, and one of the chief maritime cities of Greece. It was captured and ruined by the Persians in 490 B. C., but was soon rebuilt. Eretria was the seat of a celebrated school of philosophy, founded by Menedemus about 330 B. C.

Erfurt, ār'foort, or **Erfurth** (in Lat. *Erphordia* and *Erfurtum*): town of Prussian Saxony; on the river Gera and the Thuringian Railway; 15 miles W. of Weimar and 14 miles E. of Gotha (see map of German Empire, ref. 5–E). It has an old Gothic cathedral with a bell which weighs 275 cwt., fourteen Protestant churches, a royal academy, a public library of about 60,000 volumes, a normal school, and an edifice formerly occupied by the University of Erfurt, which was founded in 1392 and closed in the year 1816. The Augustine convent of which Luther was an inmate for several years is now used as an orphan asylum. Erfurt has manufactures of silk, cotton, and woolen fabrics, hosiery, shoes, leather, etc. It was more populous in the Middle Ages than it is now. The Congress of Erfurt, held here in Sept.–Oct., 1808, was attended by Napoleon, Alexander I. of Russia, and several of the German princes. In Mar. and Apr., 1850, the so-called Union Parliament held its sessions here. See GERMANY. Pop. (1885) 58,385; (1895) 78,167.

Erg, ėrg: the absolute (C. G. S.) unit of work or of energy. It is the work of one dyne acting through a centimeter distance. The relation of the erg to the usual practical units of work and power is as follows:

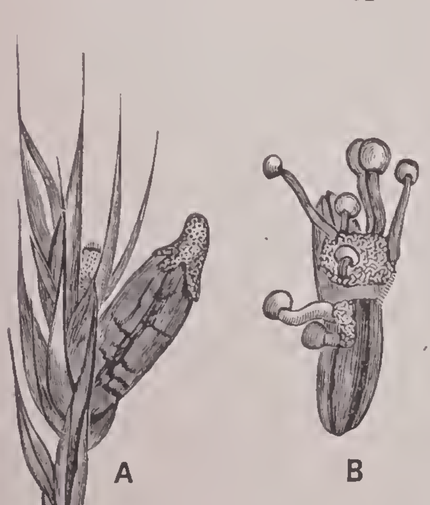
1 kilogrammeter = 100,000 g. ergs.
1 foot-pound = 13,825 g. ergs.
1 watt = 10^7 ergs per second.
1 horse-power = 746×10^7 ergs per second.
1 horse-power (French) = 736×10^7 ergs per second.

E. L. NICHOLS.

Erg: the most northern of the areas of sand wastes in the Sahara Desert. These sand regions are called by various names by the tribes around them. Those just S. of Algeria are called Erg or Areg, and divided by the Wadi Mia into East and West Erg. The East Erg is the best known sand region of the Sahara. Singing sands are found in the Erg, and in many places the sand is heaped into great dunes. See Duveyrier, *Le Pays Touareg*. C. C. ADAMS.

Ergograph: See RECORDING APPARATUS, PSYCHOLOGICAL, in the Appendix.

Ergot, or **Spur** [Fr. *ergot*, a cock's spur; etymol. unknown]: a curious fungus, the compact mycelium of the *Claviceps purpurea* of Tulasne, growing frequently in the heads of rye (then often called spurred rye), though found on all grasses and some *Cyperaceæ*. It was long believed to consist of diseased kernels of rye, but microscopical examination shows that it has nothing at all in common with the rye, but, growing originally from the ovary, it naturally assumes something of the shape of the mould in which it grows.



Ergot: A, in head of rye; B, ergot germinating. In the little heads many spores are produced which serve to propagate the fungus.

Ergot is usually shaped somewhat like a cock's spur, and is from half an inch to $1\frac{1}{2}$ inches long. It contains alkaloids, ergotine and ecboline, sclerotic or sclerotinic acid, and several other compounds which are little understood, including an oil which appears to be inert, and mycose, a peculiar sugar.

Ergot is much used in medicine, especially for the purpose of exciting uterine contractions after the child's head is born. As a rule, it should never be administered except by persons skilled in its use. The contractions induced by ergot differ from the natural uterine effort, which is intermittent, with intervals of more or less perfect rest, while ergot causes a uniform and constant expulsive effort. In skilled hands it is a remedy of great value. Administered late in labor, it often prevents dangerous loss of blood, and it is further useful in some cases of menorrhagia and other hæmorrhages. It is also useful in vertigo, and probably in other diseases requiring treatment because of functional disorder of the muscular coat of the blood-vessels.

Revised by CHARLES E. BESSEY and H. A. HARE.

Ergotism: a disease or condition resulting from long-continued use of grain in which ergot is mixed. This condition is one which has been known from remote times, and most devastating epidemics of it have occurred in Europe. In America no cases have ever been observed; but it is said that in 1819 an epizoötic of this nature occurred among cattle in a part of New York, caused by ergot in the blue-grass crop. The symptoms of ergotism may be roughly classified in two groups, the nervous and the gangrenous, though cases usually present a mixed type. In the nervous form there is tingling and twitching, with later more or less spasmodic condition of the muscles, and as the disease grows more severe mental disturbances, delirium, stupor, and coma. At the same time various gastric disturbances manifest themselves, but especially ravenous hunger. Recovery may ensue, but not infrequently the patient is left palsied, or subject to habitual spasms, mental aberration, or even idiocy. In the gangrenous form intense itching and tingling of the skin, followed by appearance of a red or darkish spot on the extremities, and after this a form of dry gangrene, as a result of which the hands or feet may be lost, or death ensue.

The cause of ergotism lies in the consumption as food of rye or oats tainted with the ergot parasite, and in many cases it seems the lack of sufficient food played some part in the causation aside from the specific action of the ergot itself. In certain years, especially when the summer is cold and damp, the grain is more apt to be diseased than in other years. Nothing can be done in the way of treatment, except to maintain the strength and minister to the comfort of the patient. The medicinal use of ergot may lead to a form of acute poisoning in which vomiting, purging, and progressive loss of power play a part, but very few cases of chronic ergotism have arisen in this way.

WILLIAM PEPPER.

Er'ic XIV.: King of Sweden; b. Dec. 13, 1533; a son of Gustavus Vasa, whom he succeeded in 1560. He made overtures of marriage to Queen Elizabeth of England, to Mary Queen of Scots, and others, but finally married a Swedish peasant named Catharine Monsdotter. He was capricious, imprudent, momentarily insane, and always addicted to violent paroxysms of anger and cruelty. In his reign Sweden was involved in a war against Denmark. Several noblemen were unjustly put to death by his order. A conspiracy was formed against him by his own brothers and other nobles, who deposed him in 1568, and confined him in prison, where he died Feb. 16, 1577.

Ericsson, JOHN, Ph. D., LL. D.: engineer, naval constructor, physicist, and inventor; b. at Långbanshyttan, Sweden, July 31, 1803; fourth in descent from Magnus Stadig, a miner, who died in 1739. His father, Olof Ericsson, was a graduate of the gymnasium of Karlstad, and John received a thorough training in the studies fitting him for his profession, having the advantage of instruction by engineers sent by Thomas Telford from England to superintend the construction of the Göta Canal. In 1814 he was appointed a cadet of the Swedish Corps of Engineers, and in 1820 an ensign in the Swedish army, where he rose to the rank of captain. In the army he acquired valuable experience as an artillerist, and gained such skill in topographical drawing that while engaged in surveying and mapping Northern Sweden his labor was counted as that of two men. He showed precocious talent as an inventor, designing at the age of ten years a pump to drain the mines, and inventing before he reached his majority a machine for engraving and a flame-engine. The desire to find a larger field for his flame-engine induced him to resign from the army, and remove in 1826 to England, where he remained until Nov. 1, 1839, engaging in business there as a partner of John Braithwaite. He made use of surface condensation as applied to steam in Sir John Ross's arctic vessel the Victory in 1827. In 1828 he employed compressed air to convey power to a Cornwall tin-mine lying off the shore, and in 1829 he used artificial draught in a steam fire-engine designed by him and successfully tested in England and on the Continent. In the same year he applied artificial draught to his locomotive the Novelty, which entered the lists against Stephenson's Rocket in the famous contest at Rainhill in Oct., 1829, that opened the era of travel by rail. Leading engineers of that time placed on record the statement that the Novelty was the first engine that ever ran really fast, as it ran a mile in fifty-six seconds, and that it was long remembered as a beau-ideal of a locomotive. In 1832 Ericsson made the first use of the centrifugal fan-blower in the Corsair, and he used steam in many new and ingenious ways. In 1833 he patented a "caloric" engine with an "organ-pipe regenerator." This excited extraordinary interest in London, and laid the foundation for his future inventions in that line. In 1833 he conducted experiments with submerged propellers, and in 1838, in the iron screw-steamer the Robert F. Stockton, made the first really successful application of the screw to steam-navigation, coupling his engine directly to the propeller shaft. Discouraged by English indifference to his advanced ideas, Ericsson removed to the U. S., arriving Nov. 23, 1839, in New York, where he continued to reside until his death. During the years immediately succeeding his removal he made extensive application of the screw-propeller to merchant vessels on the inland waters of the U. S., and in 1843 caused a revolution in naval warfare by applying the screw to the U. S. S. Princeton by making use of ideas and inventions formerly regarded as inapplicable to the conditions of war. He was the first to employ a range-finder, to discard the use of breeching for heavy guns, to put his machinery below the water-line and to protect it with coal armor. The first practical application of twin-screws was made by Ericsson in the Marmora in 1843. During the twenty years from 1841 to 1861 he was engaged at intervals in work upon revenue marine and other Government vessels, some of which were used during the war with Mexico, 1846–47. He also undertook various bold inventions and constructions, not all of which were successful. Chief of these was the caloric ship Ericsson, which voyaged, Feb., 1853, between New York and Washington, and demonstrated the impossibility of superseding steam with hot air. However, Ericsson successfully applied hot air to the production of small powers, and thus made it a commercial success. His studies in the application of steam-power to war-vessels culminated in the invention of the Monitor armor-clad, made in 1854 and first practically applied in the original Monitor, which defeated the Merrimac in Hampton Roads, Va., Mar. 9, 1862, stayed the rising tide of Confederate success, and compelled the reconstruction of every great navy, substantially upon the lines laid down by Ericsson. During the civil war, from 1862 to 1865, he was occupied in the work of building a monitor fleet for the U. S. In 1869 he built for Spain a fleet of gunboats designed for Cuban waters. In 1878 he developed in the torpedo-boat Destroyer ideas included in his scheme of naval warfare first conceived and submitted to Napoleon III. in 1854. In 1866 he entered upon the study of solar physics and devoted most of the remaining twenty-three years of his life to this, expending $100,000 in experiments and the construction of ingenious apparatus to facilitate his studies. Most of this apparatus was transferred upon his death to the Metropolitan Museum of Art, New York. He invented a solar engine, which he left as a legacy for the future time, when the coal mines shall cease to supply the world with concentrated heat. The main purposes of Ericsson's inventive studies through life were (1) to secure an economical substitute for the steam-engine or lessen its waste of power; (2) to devise some simpler and less dangerous motor; and finally so to improve the mechanism of defense in war that the weaker nations should no longer be at the mercy of the strong. Ericsson died in New York city, Mar. 8, 1889, the anniversary of the battle between the Monitor and the Merrimac. He was a man of extraordinary physique, having the muscular strength of two ordinary men, and retained his ability to work twelve or fourteen hours a day almost up to his dying hour. Numerous titles, diplomas, medals, and orders of knighthood testified to the public appreciation of his services. After his death the Swedish Government asked for the return of his body to his native land, and it was transferred with distinguished honors, in the U. S. S. Baltimore, to Stockholm, where it was received with like honors and conveyed to its final resting-place in a mortuary chapel at Långbanshyttan. He left no descendants, his only son dying before him without issue. In 1890 the Legislature of New York appropriated $10,000 for the erection of a monument to this great inventor, and the ceremony of unveiling took place in Battery Park, New York city, Apr. 26, 1893.

WILLIAM CONANT CHURCH.

Ericsson, NILS: brother of John Ericsson; engineer; b. at Långbanshyttan, Sweden, Jan. 31, 1802. He was in 1814 appointed cadet of the Swedish Corps of Mechanical Engineers, and engaged upon the Göta Canal, ultimately being placed in control of it and completing it. He was then given charge of the construction of a system of Government railways, and on completing them, in 1862, he was created a baron and retired with the largest pension ever bestowed upon a Swedish subject. He and two of his sons were members of the Swedish Diet, and the eldest son, John, who inherited the title of baron, is governor of Jemtland, Sweden. Nils Ericsson died in Stockholm, Sept. 8, 1870.

WILLIAM CONANT CHURCH.

Erie: city (founded in 1867); capital of Neosho co., Kan. (for location, see map of Kansas, ref. 7–J); on Atch.. Top. and S. Fé and M., K. and T. Railways; 116 miles S. by W. of Kansas City; near the Neosho river, which supplies excellent water-power. The city has four churches. The chief industries are agriculture and stock-raising. Pop. (1880) 270; (1890) 1,176; (1900) 1,111. EDITOR OF "REPUBLICAN RECORD."

Erie: city and important railway and commercial center; capital of Erie co., Pa. (for location of county, see map of Pennsylvania, ref. 1–A); the only lake port of the State; has the largest landlocked harbor on Lake Erie, 5 miles in length by one in width. A line of first-class propellers runs between this port and the upper lakes; the imports are principally grain, lumber, iron ore, limestone, and plaster, and the exports bituminous and anthracite coal, engines, boilers, and other manufactured products of the city. Railway facilities are excellent. Erie is on the L. S. and M. S. and the N. Y. C. and St. L. railways; it is the western terminus of the Phila. and Erie Railroad, penetrating the lumber and upper oil regions of the State, and connecting with Harrisburg, Philadelphia, and the anthracite coal-fields; and is also the northern terminus of the Erie and Pittsburg and the Pittsburg, Shenango and Lake Erie railways, which pass through the bituminous coal sections and the lower oil regions of the State, and furnish direct connection at Pittsburg with all rail and river routes.

Manufactures, etc.—The facilities for receipt of raw material and cheap fuel, and for the shipment of products by rail and water, make Erie an important manufacturing center. Articles in great variety are manufactured here; among the chief are the products of foundries, machine-shops, and flouring-mills. Erie is the market for a rich farming country. It has a fine Government building, in which are located the post-office, customs and internal revenue offices, district court-rooms, and signal-service station; an academy, electric street railways and street lighting, and an excellent water-works system, owned by the city and valued at $1,500,000. It is the largest and most central point in a section covering the ten northwestern counties of Pennsylvania. Pop. (1880) 27,737; (1890) 40,634; (1900) 52,733.

EDITOR OF "DISPATCH."

Erie Canal: the most important, as well as the largest, canal in the U. S., extending from Buffalo to Albany, N. Y., 363 miles long. De Witt Clinton, whose name is identified with the construction of this great public work, was in 1810 appointed a member of a commission to explore and survey a route for the proposed canal from the lakes to the Hudson; and his memorial to the State Legislature in 1815 insured the success of the undertaking. The bill for its construction was passed in 1817; but the "canal policy" was for years strenuously opposed. In 1825 the canal was completed at a cost of $7,602,000, and navigation was opened in October. Clinton was at that time Governor of the State of New York, and at the head of a grand naval procession he sailed down the Hudson from Albany to the sea, and poured a keg of the water of Lake Erie into the Atlantic Ocean. In construction the canal presents features of paramount interest. It is carried over several large streams on stone aqueducts whose construction required the greatest engineering skill. It crosses the Mohawk river twice, at Schenectady and at Cohoes. It has in all 72 locks, of which 57 are double and 15 single. At Albany it rises 20 feet by two double locks, 110 by 18 feet, and at West Troy it is carried over a ridge 188½ feet high by 16 double lift-locks. The commercial importance of this canal is very great. It is chiefly employed for transporting grain and such articles as do not require quick transit, and its navigation is free. It is being deepened and widened for the passage of larger vessels. See CANALS and CLINTON, DE WITT.

Erie Clay: one of the Pleistocene formations of the region of the Laurentian lakes. It occupies lowlands about Lakes Ontario and Erie, and about the southern parts of Lakes Huron and Michigan. Like the till on which it rests, it contains pebbles and bowlders, scratched and polished by glacial action; unlike the till, it is finely laminated. Its color is usually some shade of gray or blue, changing at top, through oxidation, to yellow. The clay was deposited in a series of lakes which bordered the great Pleistocene ice-sheet during its final retreat. See GEOLOGY, HISTORIC; also PLEISTOCENE. G. K. G.

Erie, Lake: one of the chain of great lakes drained by the St. Lawrence; constitutes part of the boundary between the U. S. and Canada. The province of Ontario adjoins it on the north, and the States of New York, Pennsylvania, Ohio, and Michigan on the south, east, and west. The Detroit river, entering from the north near its west end, brings the discharge of the upper lakes, and is its largest tributary. The Grand enters from the north, the Maumee from the west, and the Cuyahoga from the south. Its outlet, the Niagara, flows northward from its east end. The length of the lake is 246 miles, its greatest width 58 miles, and its area 9,900 sq. miles. Its surface lies 573 feet above the sea and 326 feet above Lake Ontario. It is the shallowest of the great lakes, its general depth being less than 100 feet and its deepest sounding 210 feet. A group of islands near its west end are celebrated for their vineyards. Its commerce is large, passing westward through the Detroit river to the upper lakes, eastward through the Welland Canal to Lake Ontario, and southeastward viâ the ports of Buffalo, Erie, and Cleveland.

The important BATTLE OF LAKE ERIE was fought near the western extremity of the lake between a squadron of U. S. vessels commanded by Lieutenant (afterward Commodore) Perry, and a British squadron of six vessels under Capt. Barclay, Sept. 10, 1813. Perry's squadron, consisting of nine vessels, but manned by an inferior force and mounting fewer guns, captured the entire British squadron after three hours' combat. This battle gave the U. S. the supremacy on the lake, and permitted the co-operation of the land and naval forces in the West, with the result of freeing Michigan from the British occupation. G. K. G.

Eries: See IROQUOIAN INDIANS.

Erie Shale: the name given by the Ohio geologists to the westward extension of the Chemung and Upper Portage rocks of New York. The oil-wells of Western Pennsylvania are bored on this foundation, though the petroleum which is found in it emanates from the Huron shale below.

Erig'ena, JOHANNES SCOTUS: the boldest and most brilliant thinker of the ninth century. The events of his life are involved in some obscurity. He was born probably in Ireland between 800–815 A. D., and educated in the Irish monasteries. His name, Erigena, is probably a corruption of Hierugena, i. e. "of the Holy Isle," a common designation of Ireland. About 843 he appears to have gone to France, where he was patronized by Charles the Bald. He is credited with one of the best repartees on record. At table one day the king asked him, "Quid distat inter sotum et Scotum?" (What is the difference between a sot and a Scot?). Erigena instantly replied, "Mensa tantum" (Only the table). What happened to him after the death of Charles the Bald, in 877, is not so clear, but he died soon after, probably in France. According to another account, he went to England about 883, on the invitation of Alfred the Great, and was murdered by his pupils at Malmesbury in 891. Some who deny the Malmesbury story say that Scotus Erigena has been confounded with an Anglo-Saxon monk whom Alfred invited over from France to teach at Oxford. Erigena has been called "the morning star of scholasticism." He rebelled against Augustinianism, asserted the supremacy of reason, and wrought out a vague pantheism. He also translated into Latin the works (spurious) of Dionysius the Areopagite (of the fourth or fifth century), and thus planted the seeds of the mediæval mysticism. He wrote against Gottschalk (851 A. D.) on predestination, and against Paschasius Radbertus on transubstantiation, and was condemned as a heretic at Paris in 1209. Of his other works, the most important is a treatise in five books, *De Divisione Naturæ*. It was printed at Oxford in 1681. The best editions are those by C. B. Schlüter (Münster, 1838) and H. L. Floss (Paris, 1853, see below); German translation by L. Noack (3 pts., Leipzig, 1874–77). It is written in the form of a dialogue, and the process of reasoning moves on through syllogisms. But his speculation is very free and bold. It is not the given system of theology he will explain, but an original aspect of the universe which he wishes to set forth, and in the exposition of which he appeals to no external authority. In direct opposition to the theologians of his time, and to the schoolmen in general, he does not start from a conception of the body of theological doctrines as being the truth, needing only elucidation. His starting-point is a philosophical conception of the universe. Pope Honorius III., in 1225, characterized his book as "teeming with the vermin of heretical depravity," and ordered all copies of it to be burned. His works, edited by H. L. Floss, are in Migne's *Patrologia Latina, CXXII.* (Paris, 1853). See Christlieb, *Leben und Lehre des Johannes Scotus Erigena* (Gotha, 1860), and Huber, *Johannes Scotus Erigena* (Munich, 1861). Revised by S. M. JACKSON.

Erigeron, ĕe-rig'e-rŏn [Gr. ἠριγέρων, early-old; ἦρι, early + γέρων, old man; so named in allusion to their hoary appearance]: a genus of herbs of the family *Compositæ*, including the fleabanes (which are weeds of several species, very common in Europe and North America) and other plants, such as robin's plantain (*Erigeron bellidifolius*), etc. The *Erigeron philadelphicus*, *Erigeron canadensis*, and others are used as diuretics, and contain a volatile oil which varies somewhat in different species. The oil has a pungent, disagreeable odor, and sometimes also a tarry or oleo-resinous character. It is used in medicine.

Revised by CHARLES E. BESSEY.

Erik the Red: the discoverer of Greenland, and, Greenland being a part of the western hemisphere, probably the first white man who visited America. He was born about the year 950 in Jædern, in Norway, whence he with his father, Thorwald Osvaldson, removed to Iceland on account of manslaughter. From Iceland he was banished on account of another case of manslaughter, and so he set out on a voyage of discovery. One Gunnbjorn, son of Ulf Krage, had seen land lying in the ocean to the west of Iceland, when in the year 876 he was driven out to sea in a storm. Erik the Red resolved to go in search of the land that Gunnbjorn had seen. He sailed W. from Iceland, and in 982 he discovered the unknown land, which he called Greenland, in order, as he said, to attract settlers, who would be favorably impressed with so pleasing a name. After remaining there three years he returned to Iceland. In 986 he returned to Greenland, accompanied by many new settlers, who established a colony in Eriksfjord, which is thought to correspond to the present Tunnudliarbik and surroundings. Erik the Red lived at Bratlahlid, which after the death of Erik's descendants became the residence of the lagman. Erik's son Leif was the discoverer of America (Vinland). See LEIF ERICSSON and VINLAND.

RASMUS B. ANDERSON.

Erin: See IRELAND.

Erina'ceus [Lat. *erina'ceus*, hedgehog]: the genus that includes the hedgehogs of the Old World, of which there are several species, inhabiting Asia, Africa, and Europe. The common hedgehog of England may be considered a type of the group. It is a harmless little nocturnal animal, which subsists mainly on insects, though sometimes eating fruit and even reptiles. The back of the hedgehog is covered with spines, and when attacked he rolls himself into a ball from which they radiate in every direction, and serve as a defense that enables him to defy all his enemies but man. Zoölogically the hedgehog is of special interest, as he stands at the head of the order of Insectivora. See HEDGEHOG.

Erin'na (in Gr. Ἤριννα): a Greek poet who lived about 600 B. C., and was a friend of Sappho. She acquired a high reputation by her lyric and other poems, among which was *The Distaff*. It is said that she died at the age of nineteen. Fragments of her poems may be found in Bergk's *Poetæ Lyrici Græci*.

Erin'nys (in Gr. Ἐριννύς, or Ἐρινύς), plu. **Erinnyes**: a name given to the Furies or EUMENIDES (*q. v.*).

Erioden'dron [from Gr. ἔριον, wool + δένδρον, tree]: a genus of evergreen trees of the family *Malvaceæ*, natives of tropical climates. They have large and beautiful flowers. They are sometimes called wool-trees, because the capsules inclose a fibrous woolly or cottony substance. The cotton of *Eriodendron samanna* is used in Brazil for stuffing pillows. The *Eriodendron anfractuosum*, which grows in the West Indies, has edible seeds, and is grown in greenhouses as a fine ornamental plant. The cotton produced by these trees can not be spun, but its use in paper manufacture has been proposed. Revised by CHARLES E. BESSEY.

Eritrea, ā-rēē-trā'ăă: an Italian colony on the African coast of the Red Sea, organized in 1890-91. It extends along the coast a distance of 670 miles from Cape Kasar, lat. 18° 2′ N., to the Strait of Bab-el-Mandeb in lat. 12° 30′ N. (see map of Africa, ref. 4–G). The west boundary extends to the latitude of Kassala, but does not include that town, which has been restored to Egypt. The southern boundary as fixed by the treaty concluded with Abyssinia, Oct. 26, 1896, is the river Mareb with its tributary the Belesa, and the Muna, which flows eastward; area about 88,500 sq. miles; pop. estimated at 450,000. The climate is generally tropical and water scanty in the colony proper. Little agriculture is practiced, and cattle, hides, and tallow are the chief exports. Pearl-fishing is carried on at Massowa and Dahlak. There is a telegraph line of 318 miles from Massowa, through Assab, to Perim, and a railroad, 17 miles, from Massowa to Saati. Massowa is the capital, with a population in 1893 of 7,775, of whom 600 were Europeans and 480 Asiatics. The colony is autonomous, the central government at Rome being represented by a civil governor, who is under the direction of the Minister of Foreign Affairs.

Erivân′ (in Lat. *Erivana*; Pers. *Rewân* or *Revân*): a fortified town of Russian Armenia; government of Erivan; on the river Zenga, near where it flows into the Aras; 115 miles S. by W. from Tiflis (see map of Turkey, ref. 4–J). It has a citadel on a high rock, several Armenian churches, a large bazaar, and a few mosques; also a cannon-foundry and manufactures of cotton goods, earthenware, and leather. It was stormed and taken by the Russian general Paskewitch in 1827, and was ceded to Russia by Persia in 1828. Pop. (1874) 30,000; (1897) 28,910.

Erlangen, ār'lăăng-en: a handsome town of Bavaria; on the river Regnitz and on the railway from Bamberg to Nuremberg; 11 miles N. of the latter (see map of German Empire, ref. 6–E). It is partly inclosed by the ancient walls, and is divided into the old and new town, the latter of which is very well built. Here is the University of Erlangen, which was founded in 1742, and is celebrated as a school of Protestant theology. It has a library of about 150,000 volumes, a botanical garden, and manufactures of hosiery, gloves, mirrors, plate-glass, combs, and hats. Pop. (1890) 17,565.

Erlau, ār'low (in Hung. *Eger*; Lat. *Agria*): city of Hungary; capital of the county of Heves; on the river Erlau, or Eger; about 75 miles E. N. E. of Budapest (see map of Austria-Hungary, ref. 5–H). It is inclosed by walls, and is pleasantly situated amid vine-clad hills. It has a cathedral, a bishop's palace, a gymnasium, a normal school, a lyceum, a richly endowed hospital, and manufactures of linen and woolen fabrics; also an extensive trade in red wine of superior quality, which is produced in the vicinity. Erlau is a very old town and was formerly fortified. A bishopric was founded here in the eleventh century. Pop. (1890) 22,200.

Erl′king (in Germ. *Erlkönig*; Dan. *Elverkonge*, i. e. king of the elves): in German and Scandinavian mythology, a fabulous being which, through seductive allurements, causes injury and destruction to human beings, especially to children. This tale has become widely known through the ballad of that name by Goethe.

Ermenonville, ār'me-nōṅ-veel′: a small village of France; department of Oise; 7 miles S. E. of Senlis (see map of France, ref. 3–F). Here is a beautiful château with an extensive park, which is visited in summer by many Parisians; also the tomb of J. J. Rousseau, who died here in 1778.

Erment: See HERMONTHIS.

Ermine: in heraldry, one of the furs used in blazonry. It represents the skin of the ermine, white, spotted or timbered with black. The arrangement of the spots varies with the wearer's rank. A black fur with white spots is called *contre ermine* or *ermines*.

Ermine, or **Stoat**: a species of weasel (*Putorius erminea*) inhabiting the cooler portions of Europe and Asia. Its body is about 10 inches long and the tail about 5 inches. It preys upon mice, poultry, eggs, young rabbits, etc., and like the other weasels has the power of emitting a most offensive

Ermine or stoat.

odor when irritated. In the summer the color of the upper parts is a pale reddish brown, and that of the under parts nearly white. In winter the whole of the body is covered with white fur, slightly tinged with yellow, but the tip of the tail remains black in all seasons. This change is not brought about by shedding the brown coat and growing a white one, but is caused by a change in the color of the hair itself, which turns white shortly after the first fall of snow. The fur is closer and finer in winter, and that which is obtained from Siberia, Norway, and other cold countries is one of the most valuable of furs. It is used for ladies' winter apparel and for the robes of kings and nobles. When made up the tails are inserted one to each skin, at regular distances and in the quincunx order or otherwise, according to the wearer's rank. The fur called miniver is a variety of spotted, "powdered," or "timbered," ermine. The ermine fur forms the distinctive doubling of the state robes of sovereigns and nobles, as well as of their crowns and coronets. It is also worn by judges in some countries. North America furnishes a very small part of the ermine fur of commerce, although most fur so called is simply white rabbit fur, with spots of black rabbit fur inserted.

The common stoat of Great Britain produces a fur much inferior to that of the same species in the far north. It is regarded as vermin, and is a most destructive pest among rabbits, hares, and fowl, wild and domestic. It is caught in snares or traps. It is most active by night.

Revised by F. A. LUCAS.

Erne, or **Earn** [O. Eng. *earn*, connected closely with Germ. *Aar*, eagle, Goth. *ara*, Gr. ὄρνις, bird]: a local English name for the sea-eagle (*Haliaëtus albicilla*).

Erne: a river of Ulster, Ireland; flows nearly northwestward through the county of Fermanagh, and expands into two beautiful lakes, called Upper and Lower Lough Erne. After a course of 72 miles it enters Donegal Bay. The Lower Lough is 20 miles long, 7 miles wide, and over 200 feet deep. The Upper Lough is smaller. Each incloses numerous islands. The banks of these lakes and of the river present fine scenery. The town of Enniskillen stands upon an island between the loughs. On another island is the seat of the Marquis of Ely. The loughs cover 40,000 acres, and are 140 feet above the sea. The salmon and other fisheries are very productive. The river and both loughs are deep, and have lines of steamboats, but the river has several cataracts.

Ernest, or **Ernst**: Elector of Saxony; the founder of the line called Ernestine or Ernestinian; b. Mar. 25, 1441. He succeeded his father, Frederick II., in 1464, and annexed Thuringia to his domains in 1482. "This prince loved a quiet life, and sought it by all the means in his power, at the same time permitting no man to offend him with impunity." He did much for the development of the resources of his territories. D. Mar. 22, 1486.

Ernest (Ernst) I., surnamed THE PIOUS: Duke of Saxe-Gotha; b. at the castle of Altenburg, Dec. 24, 1601; a brother of the famous Bernard of Saxe-Weimar. In the Thirty Years' war he served with distinction under Gustavus Adolphus as a colonel of horse. He completed the victory of the Swedish army at Lützen, where Gustavus was killed. He was a zealous Protestant, and a ruler of great wisdom and activity. He instituted reforms, some of which were very fruitful of good. Many of his institutions were lasting. D. in 1675.

Ernest (Ernst) IV., or **Ernest II.** of Saxe-Coburg-Gotha: Duke of Saxe-Coburg; b. at Coburg, June 21, 1818. His younger brother, Albert, married Queen Victoria of England. He succeeded his father in 1844, and sympathized with the efforts to promote the unity and nationality of the Germans. He composed operas entitled *Zaïre*, *Casilda*, *Sainte Claire*, *Diana de Solanges*, and wrote some memoirs. In 1863 he declined the crown of Greece. D. Aug. 22, 1893, at Coburg, the Duke of Edinburgh succeeding him.

Ernest Augustus: King of Hanover; b. June 5, 1771; fifth son of George III. of England. He was styled the Duke of Cumberland before he became king, and was a field-marshal in the British army. On the death of his brother, William IV., in 1837, he inherited the throne of Hanover, which was then separated from Great Britain, because it was not lawful for a woman to reign over Hanover. He was the object of intense popular dislike both in England and Germany. In the House of Lords he belonged to the extreme Tory party. In Hanover he was a tyrant, and in 1837 expelled from the University of Göttingen seven professors of liberal tendencies. In 1848 he was forced, in order to keep his throne, to grant some liberal reforms. D. Nov. 18, 1851.

Ernesti, ār'nes-tēe, August Wilhelm: philologist: b. in Thuringia, Nov. 26, 1733; a nephew of Johann August Ernesti. He became a good Latin scholar, and was Professor of Eloquence at Leipzig in 1770. He produced a good edition of Livy (3 vols., 1769) and other works, several of which were explanatory of the text of Livy's writings, and are still valued. D. July 20, 1801. See Bursian, p. 400 ff., *Allg. Biogr.*; *Allg. deut. Biogr.*, vi., pp. 235–242.

Ernesti, Johann August: a German critic and the founder of a school of theology; b. at Tennstedt, in Thuringia, Aug. 4, 1707. He was liberally educated at Wittenberg and Leipzig, and was so excellent a Latin scholar that he was called the "German Cicero." He became Professor of Ancient Literature in the University of Leipzig in 1742, and obtained the chair of Rhetoric in 1756, to which the chair of Theology was added in 1758. In theology he was liberal or rationalistic. He was the founder of the grammatico-historical exegetical school of New Testament interpretation in his *Institutio Interpretis Novi Testamenti* (Leipzig, 1761; 5th ed. by C. F. Ammon, 1809; Eng. trans. by Moses Stuart, *Elements of Interpretation*, Andover, Mass., 1822; n. e. by E. Henderson, London, 1827; 3d ed. 2 vols., 1832). He wrote other theological works, and published an excellent edition of Cicero (6 vols., 1737–39), including a *Clavis Ciceroniania*. D. in Leipzig, Sept. 11, 1781. See A. W. Ernesti, *Memoria J. A. Ernesti* (1781); J. van Voorst, *Oratio de J. A. Ernesto* (1804).

Ernst, Oswald Hubert: soldier; b. near Cincinnati, O., June 27, 1842; entered Harvard College July, 1858; graduated at the U. S. Military Academy in June, 1864, and was commissioned first lieutenant in the corps of engineers; served as assistant chief engineer of the Army of the Tennessee to the close of the Atlanta campaign; was detached to serve as astronomer with the commission sent by the U. S. Government to Spain to observe the solar eclipse of Dec., 1870; instructor of practical military engineering and military signaling and telegraphy at the U. S. Military Academy. He became assistant engineer on Western river improvements 1878–80, and afterward took charge of the river and harbor improvements in the district whose headquarters are at St. Louis, Mo. He has served since 1880 as member of various boards of engineers, and has directed various surveys and examinations of rivers; member of Mississippi river commission May, 1888; on duty in Mexico under orders of Department of State Nov.–Dec., 1888; in charge of public buildings and grounds, Washington, D. C., 1889–93; superintendent U. S. Military Academy Apr., 1893. He was breveted captain in 1865, commissioned captain of engineers in 1867, and major of engineers May 5, 1882. His principal publication is a *Manual of Practical Military Engineering* (1873). Revised by James Mercur.

E'ros (in Gr. Ἔρως, gen. Ἔρωτος): the Greek name of the god of Love, the Cupido of the Romans. In Hesiod, Eros is one of the great cosmogonic powers, but later poets represent him as a son of Aphrodite. See Cupid.

Eros: asteroid. See Asteroids.

Erosion [from Lat. *ero'sio*, deriv. of *ero'dere*; *e*, out + *ro'dere*, gnaw]: in geology, the action of a current of water, as in a river, in excavating or enlarging its channel, the gradual abrasion of strata, by rain, frost, glaciers, etc. The deep hollows occupied by most lakes and rivers are supposed to have been formed by the action of rivers or glaciers, and are called "valleys of erosion." The action of atmospheric agencies, glaciers, etc., in wearing away the general surface of a country or district is called *surface erosion*, *degradation*, or *denudation*. The changes wrought by this agency on the superficial features of the earth are much more grand and interesting than they are generally supposed to be; and it may be said that the surface configuration of the earth and the whole "aspects of nature" are the result of the antagonistic action of surface erosion and internal elevatory forces. See Geology.

Erpe'nius, or **Van Er'pe**, Thomas: Orientalist; b. at Gorkum, Holland, Sept. 7, 1584. He studied theology at Leyden, and took the degree of Master of Arts in 1608, after which he visited France, England, Italy, and Germany. In 1613 he became Professor of Arabic and other Oriental Languages (with the exception of Hebrew) at the University of Leyden. A second chair of Hebrew was founded for him in 1619. He printed a number of Arabic works with a press which he kept in his own house. He produced in 1613 an *Arabic Grammar*, the first ever written in Europe, prepared an Arabic chrestomathy, and published *Historia Saracenica*, which is an edition of Elmacin's history, with a Latin translation (1625). D. Nov. 13, 1624.

Errani, Achille: See the Appendix.

Errard, ār'raar', Charles: painter and architect; b. at Nantes, France, in 1606. He was patronized by Louis XIV., for whom he adorned the Louvre, Tuileries, and other palaces. He was one of the twelve artists who founded the Academy of Painting in Paris in 1648, and was the principal founder of the French Academy of Art in Rome (1666). D. in Rome, May 15, 1689.

Erratic Blocks, or **Erratics**: in geology, fragments of rocks on the surface of the ground which have been transported from a distance by glaciers, icebergs, etc. See Drift.

Errázuriz, Federico: Chilian statesman; b. at Santiago, Mar. 27, 1825. He graduated in law at the National University, was a successful advocate, and an author of some repute. Early elected to the Chamber of Deputies, he became a leader of the opposition to President Montt, and at one time was forced to leave the country. President Perez made him Minister of Public Instruction, Religion, and Justice (1861), and he brought about many needed reforms in the department; later he had the portfolio of War and Marine, and directed affairs during the war with Spain 1865–66. A combination of conservatives and moderate liberals elected him president to succeed Perez for the term of 1871–76. By instituting various reforms, and especially by the abolishment of ecclesiastical privileges, he sided rather with the liberals: public works and the reorganization of the army and navy were pushed forward with great vigor, but the treasury was heavily burdened. At the end of his term he retired to private life. D. at Santiago, July 20, 1877. Herbert H. Smith.

Errett, Isaac, A. M.: preacher, editor, and author; b. in New York, Jan. 2, 1820. His parents became identified with the Disciples of Christ in 1810, and in 1811 his father wrote in defense of the principles now advocated by the Disciples. Young Errett's boyhood was spent at Pittsburg, Pa., where, at the age of fourteen, he was baptized. He was thrown on his own resources at the age of ten, but diligently used every opportunity for increasing his stock of knowledge. In 1840 he began his career as a preacher, and soon won a wide reputation for his eloquence and power. After serving as pastor in Pennsylvania, Ohio, and Michigan, he became in 1851 corresponding secretary of Ohio Christian Missionary Society, resigning that work after three years' service to become corresponding secretary of the American Christian Missionary Society. On the death of Alexander Campbell, in 1866, he was elected its president. *The Christian Standard*, a weekly religious journal, was founded by him in 1866. He was president of Alliance College, Alliance, O., 1868–69, and then removed with his paper to Cincinnati, where he continued to reside until his death. He was the first president of the Foreign Christian Missionary Society, and retained that office until his death. Among his works are *Debate on Spiritualism* (Tiffany and Errett); *Walks about Jerusalem*; *Talks to Bereans*; *Letters to Young Christians*; *Evenings with the Bible*; and *Life of George Flower.* D. at Terrace Park, near Cincinnati, Dec. 19, 1888.

J. H. GARRISON.

Error, Writ of: See WRIT.

Ersch, JOHANN SAMUEL: bibliographer; b. at Gross-glogau, in Silesia, June 23, 1766. He studied at Halle, became Professor of Geography there in 1803, and published, besides other works, *Allgemeines Repertorium der Litteratur für 1785–1800* and *Handbuch der deutschen Litteratur seit der Mitte des 18. Jahrhunderts bis auf die neueste Zeit.* His chief work is the *Allgemeine Encyklopädie der Wissenschaften und Künste*, which he began conjointly with Gruber, and of which he edited seventeen volumes (1818–28). D. at Halle, Jan. 16, 1828. He is called the founder of German bibliography.

Erse: See GAELIC LANGUAGE.

Erskine, DAVID STEWART, F. R. S.: eleventh Earl of Buchan, and Lord Cardross; b. June 1, 1742; brother of Lord Chancellor Erskine; author of several antiquarian papers, *Lives and Writings of Fletcher of Saltoun and the Poet Thomson* (1792), and other works. He was a man of eccentric character. D. Apr. 19, 1829.

Erskine, EBENEZER: a Scottish preacher and the founder of the Secession Church; b. at Dryburgh, Berwickshire, June 22, 1680; educated at Edinburgh University (M. A. 1697). He preached at Portmoak, in Kinross, from 1703 to 1731, and acquired a high reputation. In 1731 he removed to Stirling, where he advocated popular rights in the settlement of ministers, and differed from the majority of the General Assembly in relation to lay patronage. He was deposed or suspended in 1733. In 1736 Erskine and his friends formally seceded and organized the Secession Church. He continued to preach in Stirling till his death there, June 2, 1754. In 1847 the Secession Church united with the Relief Church to form the United Presbyterian. Erskine's *Works* (mostly sermons) appeared in London 1799 (3 vols.; n. ed. 2 vols., 1826). See his *Life* by Donald Fraser (Edinburgh, 1831; 2d ed. 1834); cf. those by James Harper (Edinburgh, 1849) and John Ker (London, 1881).

Erskine, HENRY: lawyer; b. in Edinburgh, Nov. 1, 1746; brother of Thomas, Lord Erskine. He was a Whig in politics, became lord advocate of Scotland in 1782, and again in 1806. He was eloquent and witty, and was distinguished for tact and fascination of manner. During part of his career he was the most eminent member of the Scottish bar. D. near Midcalder, Oct. 8, 1817.

Erskine, JOHN: eleventh Earl of Mar; a Scottish Jacobite and ambitious politician; b. at Alloa in 1675. He was appointed secretary for Scotland in 1708. In Sept., 1715, he took arms for the Pretender, and obtained the command of about 12,000 insurgents. He was defeated by the Duke of Argyle at Dunblane in November of that year, and soon escaped to the Continent. D. in May, 1732.

Erskine, JOHN, of Carnock: Scottish jurist; b. in 1695; was a son of Col. John Erskine and a grandson of Lord Cardross. He was appointed Professor of Scottish Law in the University of Edinburgh in 1737, and filled that chair until 1765. He published in 1754 *Principles of the Law of Scotland*, and wrote an important standard work entitled *Institutes of the Law of Scotland* (1773). D. at Cardross, Mar. 1, 1768.

Erskine, JOHN, D. D.: divine; a son of John Erskine of Carnock; b. in Edinburgh, June 2, 1721, and educated there. He was ordained minister of Kirkintilloch, near Glasgow, in 1744, and of Culross in 1753. In 1758 he was translated to the New Grey Friars' church, Edinburgh, where he became the leader of the orthodox and popular party in the Church. He was promoted in 1767 to the Old Grey Friars' church, where he was a colleague of Dr. Robertson, who was the leader of the moderate party. Erskine wrote many theological works, which are highly esteemed. D. in Edinburgh, Jan. 19, 1803. See his *Life* by Sir H. M. Wellwood (Edinburgh, 1818).

Erskine, THOMAS, Lord: orator and lawyer; b. in Edinburgh, Jan. 10, 1750; the youngest son of Henry David, Earl of Buchan. His father, whose income was about £200 a year, could not afford to give him a liberal education for a learned profession. Young Erskine therefore entered the navy in 1764 as a midshipman, after he had attended the High School of Edinburgh. Four years later he purchased a commission in the army, and in 1770 he married a daughter of Daniel Moore, M. P. In the social circles of London he was admired for his elegant manners, conversational powers, and genial disposition. Renouncing the military profession, which he disliked, he resolved to study law, and was admitted as a student in Lincoln's Inn in Apr., 1775. In Jan., 1776, he entered Trinity College, Cambridge, as a gentleman commoner. It is said that in this part of his career he was very poor, suffered great privations, and boasted that he did not know a lord *out of his own family.* He was called to the bar in 1778, and obtained immediate and rapid success in his profession. One of his first clients was Capt. Baillie, prosecuted for a libel on Lord Sandwich, who was then a cabinet minister. He made his *début* in a court crowded with eminent men, yet when the judge interrupted him by the assertion that Lord Sandwich was not before the court, he had the courage to reply, "I know that he is not before the court, and for that reason I intend to bring him before the court." Lord Campbell expresses the opinion that Erskine's plea in this case was "the most wonderful forensic effort of which we have any account in our annals." In 1781 he defended Lord George Gordon, who was tried for treason and was acquitted. He was elected in 1783 to Parliament, in which his success was not so brilliant as in the forum. He was a Whig in politics, and was re-elected in 1790. In several political trials that occurred during the excitement of the French revolution he bravely defended the liberty of the press and the friends of reform whom the ministers prosecuted on a charge of constructive treason. He was counsel for Mr. Hardy and Horne Tooke, who were tried in 1794 and were acquitted. On the formation of a Whig ministry by Fox and Grenville in Feb., 1806, he was appointed Lord Chancellor, and was raised to the peerage as Baron Erskine of Restormel Castle. He resigned this office when the Tories came into power early in 1807. He was the author of *Armata*, a political romance, and a *View of the Causes and Consequences of the War with France*, which ran through forty-eight editions. D. Nov. 17, 1823. Many persons consider him the greatest advocate who ever practiced at the English bar. "He spoke," says Lord Campbell, "as his clients respectively would have spoken, being endowed with his genius; and those who heard him seemed to be inspired with a new ethereal existence." His printed speeches, enriched with noble thoughts, brilliant imagery, and beautiful diction, retain in a great measure their original impressiveness. See Lord Campbell, *Lives of the Lord Chancellors*; Lord Brougham, *Memoir of Erskine*, prefixed to a collection of Erskine's speeches (4 vols.).

Erwin von Steinbach: architect; b. at Strassburg about 1240. He was appointed in 1275 master of the works of the cathedral of Strassburg, then about half finished. He planned the west front and towers, and carried on the work until his death, in 1318. He designed other churches and monasteries in Alsace, and directed the work on the fortifications of Strassburg.

Erysipelas [Gr. ἐρυσίπελας (Hippocrates), of doubtful etymol.; cf. ἐρυσίβη, mildew, red blight; once popularly called *St. Anthony's fire*]: an inflammatory disease of the skin, caused by a specific micro-organism and associated with a peculiar rose-colored eruption of the skin, whence the name. The inflammation attending this disease is of a peculiar low type, which tends to extend. It may terminate favorably by resolution, less favorably by abscess (which is apt to be diffuse—i. e. not limited to a single spot—and is then very dangerous), or the termination may be in gangrene and the death of the patient. The disease is very common in military hospitals, seating itself in wounds, when it frequently proves fatal. Erysipelatous diseases sometimes present a distinctly infectious and almost an epidemic character. Puerperal fever, peritonitis, phlebitis, and a long catalogue of diseases of low type are akin to erysipelas. Its infectious character is admitted. The best treatment is a sustaining one. Pure air, a milk diet, and the use of quinia and iron, with stimulants, are in general indicated. Externally, it is safest to use only the blandest applications, carbolized lotions, etc.

Revised by WILLIAM PEPPER.

Erzeroum, or **Erzrum**, érz-room' [i. e. land of Rome, or Byzantium, so called because it was originally founded under the Eastern Roman empire]: town of Armenia, Asiatic Turkey, and capital of the Turkish vilayet of the same name; on a fertile plain on the river Kara-Su, a branch of the Euphrates; about 120 miles S. E. of Trebizond (see map of Turkey, ref. 4–I). It is 6,200 feet above the level of the sea. The streets are narrow and filthy; the houses are built mostly of mud, wood, or sun-dried bricks. The town has a large citadel, a custom-house, about forty mosques, several Armenian and Greek churches, and a number of bazaars. It has an extensive trade, carried on partly by caravans. The principal manufactures are of copper, tin, iron, and leather. The inhabitants own large sheep-farms in the mountains or keep sheep and cattle in the town, sending them out daily to mountain pastures. The climate is very severe, snow covering the ground for about six months. Pop. estimated at 60,000, mostly Turks. A town called *Theodosiopolis* was founded here in 415 A. D. In 1201 it was taken by Seljooks, who are said to have destroyed 100 churches. The capture of Erzeroum by the Russian general Paskievich, in 1829, brought to a successful close the Russian campaign in Asia. In the Russo-Turkish war of 1877–78 it again fell into the hands of the Russians, who held it from Feb. till Oct., 1878.

Erzgebirge, ārts-ge-beer'ge (i. e. ore mountains): a mountain-chain of Southern Germany; extending along the boundary between Bohemia and Saxony; it is nearly 120 miles in length and 25 miles broad. The Schwarzwald and Keilberg, the highest parts of this chain, have an altitude of about 4,000 feet, and are of granitic formation. The range is rich in minerals, among which are silver, tin, iron, and cobalt. On the southeast side it is steep, often rising in a perpendicular wall 2,000 feet high. On the northwest side it is broken by beautiful and fertile valleys, and gradually loses itself in the North German plain. On the northern foot of the mountains are two extensive coal-fields which, with the abundant water-power, have made this region the great industrial center of Saxony. Chemnitz, the chief town, is called the Manchester of Germany.

Esarhad'don [called in the cuneiform inscriptions *Asshur-aha-iddina*, Asshur has given a brother]: the Old Testament name of an Assyrian king, the son and successor of Sennacherib. He appears to have reigned from 680 to about 667 or 668 B. C. He is shown by the monuments to have been one of the most powerful of Assyrian monarchs. His rule extended northward to Armenia, on the W. it included Syria and Cyprus, while on the S. Egypt and even Ethiopia were claimed by him. He built a palace at Babylon. Among the numerous and splendid remains of his reign is the southwest palace of Nimrud.

E'sau (rough, hairy): the elder twin-brother of the patriarch Jacob (Israel), and the son of Isaac and Rebekah (Gen. xxv. 25). He took his name from his hairiness of body. The story of his marriage to two Canaanitish and an Ishmaelite woman, of his loss of birthright through the craft of Rebekah and Jacob, and of his quarrel and reconciliation with Jacob, is beautifully told in the book of Genesis. He was the progenitor of the Edomites, who dwelt in Mt. Seir, otherwise called Edom.

Esbjörn, ās'byörn, LARS P.: founder of the Swedish Lutheran Church in America; b. in Sweden, Oct. 16, 1808; educated at Upsala; pastor for fourteen years before emigrating to the U. S. in 1849; pastor at Andover, Ill., 1849–56; at Princeton, Ill., 1856–58; professor in Illinois State University, Springfield, Ill., 1858–60. In 1860 he organized the Swedish Augustana Synod, a body which in 1893 numbered over 84,000 communicants, and became president of its theological seminary. Returning to pastoral work in Sweden in 1862, he died there July 2, 1870. He published ten volumes and pamphlets, all in the Swedish language.

HENRY E. JACOBS.

Escalade, es-kă-lād' [Fr. from Span. *escalada*, from deriv. of Lat. *scala*, ladder, steps]: in war, an assault in which ladders are used in surmounting the obstacles presented by the scarp and counterscarp walls (or slopes) of a fortification in which no breach has been made; sometimes even a rapid blow directed at an unbesieged place with hope of success by surprise (e. g. the capture by the English troops of Almarez, Sept., 1812). Among the most famous escalades are those of Adrianople by the Goths; of Beauvais by Charles the Bold, in 1472; of Fécamp in 1593; of Prague in 1741. Still more remarkable was that at Corfù in 1717 by Count Schulenberg, who, reduced to extremity in the defense by the capture of the outworks, hastily prepared ladders, and by a desperate assault by escalade retook them, and thus saved the place. The second siege of Badajos (1812) presents an event unparalleled in the history of sieges. Two entire divisions of troops were at the moment of assault employed to escalade the defenses where intact, and each succeeded, while the regular assault on the breaches was repulsed with terrible slaughter. The castle was successfully scaled where the walls were 18 to 24 feet high, and "tolerably flanked"; the Bastion St. Vincente had a scarp-wall 31½ feet high, flanked by four guns, palisaded covered way, a counterscarp-wall 12 feet high, and a cunette ditch 5½ feet deep.

Escallop Shell: See SCALLOP SHELL.

Escanaba: city; capital of Delta co., Mich. (for location of county, see map of Michigan, ref. 3–G); situated on the C. and N. W. Railway and on Green Bay, 360 miles N. of Chicago. It has 9 Protestant and 2 Catholic churches, 4 public and 2 parochial schools, a hospital, lumber-factories, waterworks, gas and electric light, sewers, electric street railway, etc., and an excellent natural harbor. It ships annually 4,000,000 tons of iron ore and large quantities of coal, lumber, and fish. Pop. (1880) 3,026; (1890) 6,808; (1900) 9,549.

EDITOR OF "MIRROR."

Escape: in law, the departure of a prisoner from confinement before he has been released by process of law. Any liberty given to a prisoner not authorized by law is technically an escape. Escapes may occur either in civil or criminal cases. They are either negligent or voluntary—negligent, when the prisoner escapes without the consent of the officer having him in custody; voluntary, when such officer consents to the escape. In criminal cases an escape is a public offense, of which the prisoner may be convicted, as also the officer through whose act or neglect the escape occurs. An officer voluntarily permitting a criminal to escape is guilty of the same offense as the criminal, as he then becomes an accessory after the fact. In civil actions there is an important distinction between *mesne* and final process, the former being that which is issued between the commencement and the termination of the action; and the latter, that which is used to enforce the judgment. If the escape be voluntary, the officer is liable in either case; but if it be negligent, he will not be liable in the case of *mesne* process if the prisoner is again in his custody before an action is commenced against him for his neglect; though he will be liable in any event in the case of final process. The damages recoverable are measured by the injury sustained. In final process these would in general be the amount of the judgment. Nothing will excuse an escape but an act of God or of the public enemy or of the law.

Revised by F. STURGES ALLEN.

Escapement: the device in watches and clocks by which the rotatory motion of the wheels gives rise to or perpetuates the vibration of a pendulum or balance-wheel.

Escapements have received various forms, many of which are still in use. The earliest, introduced by Huyghens, about 1650, was called the crown-wheel or vertical escapement. The crown-wheel has its teeth not in the plane of the wheel, but in a cylindrical surface of which the axis of the wheel is the axis. In the crown-wheel of the clock or watch the teeth were acute-angled, and inclined in a common direction like saw-teeth. The axis of the pendulum, or balance, was longer than the diameter of the crown-wheel over which it extended. It carried two short arms or projections, called pallets, set in different azimuths, in such a manner that when one of them, being encountered by a tooth, was pushed out of the way by the advancing wheel, the opposite one was caught by another tooth, which pushed in the opposite direction. Thus the wheel made an intermittent progress as the teeth successively escaped from the pallets.

In a clock, when the pendulum is disturbed from the mean position, it is brought back by gravity. In the watch the same result is produced for the balance-wheel by the action of the spiral spring attached to the verge, called the hair-spring. The escapement most commonly in use for both clocks and watches is the anchor escapement, first introduced by Hooke in 1656. It is so called from its resemblance to the flukes of an anchor, the shaft of the anchor in the clock being parallel to the pendulum and connected with it. The escapement-wheel is a spur-wheel. The pallets project from the extremities of the anchor flukes, meeting the wheel at the points where tangent lines from the center of motion would touch it. When one pallet is engaged with the wheel the other is free, and *vice versa*. The extremity of the pallet is inclined in such a manner that, as the tooth escapes, it gives an impulse to the pendulum. As, after the pallet first engages a tooth, the swing continues for some time in the same direction, anchor escapements are of two kinds, according to the manner of their action upon the train during this swing. In Hooke's escapement the surfaces of the pallets are so inclined that by their pressure on the tooth they turn the train slightly backward, or cause it to *recoil*, up to the end of the swing. In the *dead-beat* escapement, invented by Graham early in the eighteenth century, the surfaces of the pallets are circular arcs having the center of motion for their center; so that during the swing the train simply stands still. Though the dead-beat escapement is now generally used in clocks, there are not wanting those who prefer the recoiling escapement. Besides the anchor dead-beat there are several other very ingenious forms, among which may be mentioned Lepaute's pin-wheel escapement, McDowall's ruby-disk escapement, and Denison's three-legged dead escapement.

The only escapement used for watches till about 1700 was the crown-wheel escapement. Graham invented the cylinder escapement, so called because a hollow cylinder of steel or ruby replaces in part the verge of the balance. This cylinder is cut away on one side for about one-fourth of the circumference, in order to allow the pallets, which are small triangular pieces of steel, to enter the interior. During the swing the pallet rests with little friction on the smooth exterior or interior surface. In entering and in escaping it gives an impulse to the balance. The pallet is not in the plane of the wheel, but stands on a short stem at right angles to this plane. Hence the cylinder must be much more extensively cut away at the point where the wheel passes, and on this account the cylinder escapement, though performing very well, is too frail to be popular in use. The duplex escapement of Lepine receives its name from having a double escapement. The escapement-wheel carries spur teeth rather widely separated, which engage at every double vibration with a notch in a cylinder forming part of the verge, and constructed of a gem. The verge itself carries also an arm which engages with a set of pins, or crown-wheel teeth, fixed in the escapement-wheel at right angles to its plane. The impulse is chiefly derived from the escapes of this arm, but proceeds to some extent from those of the spur teeth also. It takes place only in one direction, and hence the system is called by the French an escapement *à coup perdu*. The duplex escapement, though attended with little friction and running without oil, is subject to the disadvantage that a sudden jerk may check the swing of the balance and prevent the escape. If a single such failure occurs, the watch will stop.

The lever escapement is a dead-beat anchor escapement, first applied to the watch by Mudge, in 1793. The lever is attached to the anchor, generally crosswise, or at right angles to the proper position of the anchor-shaft. At one extremity it presents a notch into which a pin attached to the verge strikes at each swing in either direction. This tilts the anchor and allows a tooth to escape. Except at these moments of locking and unlocking, the balance swings entirely free. The lever carries also a pin just at the summit of the notch, which enters an indent in the verge as the lever passes. As there is no other indent, the lever can not tilt except when the verge pin strikes it.

The escapement which interferes least with the uniformity of movement of the train is the chronometer escapement, introduced into England in the eighteenth century by Earnshaw, though said to have originated in France. In this the train is locked by a tooth projecting from a light bar tangent to the escapement-wheel, which yields by bending and not by turning on a pivot, the fixed extremity being a spring. The free extremity carries another delicate spring parallel to itself and extending a little beyond it. A tooth on the verge passes this slight spring in one direction without sensible resistance. On its return the bar behind the spring prevents its bending, and so is carried along with it, unlocking the train. The train being released, a tooth of the escapement-wheel strikes a pin, or enters a notch, connected with the verge, and gives an impulse to the balance. This, like the duplex, is an escapement *à coup perdu*, and is liable like that to stop when subjected to sudden jerks. Hence chronometers carried on the person sometimes stop; but with nautical chronometers this accident hardly ever occurs.

The chronometer escapement is sometimes called a free escapement, since the balance is wholly free from contact with any other part of the work, except in the instant of unlocking and receiving the impulse. This is true also of the lever escapement; but in that the unlocking requires more force, and is attended with larger friction. See the article CLOCK.

Esceleu: See ESSELENIAN INDIANS.

Eschatology, es-kă-tol'ŏ-ji [from Gr. ἔσχατος, last + λόγος, discourse]: that section in dogmatics which treats of the second advent, the intermediate state, the resurrection, the last judgment, heaven, and hell. Upon these themes revelation does not go into minute details, while yet the salient points are strongly marked. The passages which must be relied upon to furnish the data are Matt. xxv., Luke xvi., xxiii. 43, John xiv. 23, 1 Cor. xv., 2 Cor. v., 2 Thess. i., ii., Rev. xx. and xxi. See FUTURE STATE.

Escheat' [from O. Fr. *eschete*, deriv. of *escheoir* < Lat. **excade're* for *exci'dere*, to fall to one's share]: a reverting of lands to their original owner (lord of the fee) because of some obstruction in the course of descent, either by failure of heirs or corruption of blood (now abolished) when the tenant had been convicted of treason or felony; also, the estate itself thus reverting. An escheat differs from a forfeiture in the fact that the latter is a penalty for a crime, and the property forfeited accrues to the person injured or the sovereign, while escheat depends solely on the failure of heirs, and the land reverts to the former owner (lord of the fee). In the U. S., where feudal tenure does not exist, the doctrine of escheat has a limited application; still, if an owner of land dies without heirs, it is said to escheat to the state. Incorporeal rights, such as ways and commons, do not escheat, but become extinct. The land of a corporation, in case it becomes extinct, reverts to the grantor, and not to the state. The state takes an escheat subject to any charges or encumbrances attaching to the land when its title accrued. A proprietor may prevent an escheat by conveying or devising his estate. In Great Britain, and generally in the U. S., the subject is regulated by statute.

Revised by F. STURGES ALLEN.

Eschenbach, esh'en-baăkh, WOLFRAM, von: mediæval poet and minnesinger; b. of a noble family, at Eschenbach, near Ansbach, Bavaria. In 1203 he went to the court of Hermann, landgrave of Thuringia, whose bounty he enjoyed until 1215. He died between 1218 and 1225. His principal poems are *Parcival* and *Willehalm*, which have also been translated into modern German, and are much admired. Though Wolfram possessed no learned education and was even unable to read, these epics rank among the greatest imaginative works in the German language. They display an exquisite humor, depth of feeling and thought, and great mastery of language. See Karl Lachmann, *Wolfram von Eschenbach*; G. Bötticher, *Die Wolframliteratur seit Lachmann*; K. Kant, *Scherz und Humor* in *Wolfram von Eschenbach*.

Revised by JULIUS GOEBEL.

Eschenmayer, esh'en-mī-er, ADAM KARL AUGUST: a German philosopher and mystic; b. at Neuenberg, Würtemberg, July 4, 1768. He became Professor of Philosophy and Medicine at Tübingen in 1811, and obtained the chair of Practical Philosophy there in 1818; removed to Kirchheim 1836, and there died Nov. 17, 1852. He wrote, besides other works, *Religionsphilosophie* (The Philosophy of Religion, 3 vols., Tübingen, 1818–24).

Eschscholt'zia califor'nica: a plant of the poppy family (*Papaveraceæ*), a native of California. It is cultivated for the beauty of its flowers, which are yellow. The calyx separates from the flower-stalk when the flower expands, and resembles the extinguisher of a candle. This genus was named in honor of J. F. Eschscholtz (1795–1831), a German botanist.

Revised by CHARLES E. BESSEY.

Eschwege, esh'vā-ge: a town of Prussia; province of Hesse-Nassau; on railway and on the river Werra; 28 miles E. S. E. of Cassel (see map of German Empire, ref. 4–E). It has a castle, a Realschule, and manufactures of linen and woolen goods. Pop. (1890) 9,787.

Eschweiler, esh'vī-ler: town of Rhenish Prussia; on railway from Cologne to Aix-la-Chapelle; 8 miles E. N. E. of the latter (see map of German Empire, ref. 5–C); has extensive manufactures of ribbons, canvas, needles, glass, machinery, and woolen goods. There are mines of coal, zinc, and lead in the vicinity. Pop. (1890) 18,119.

Esclot, BERNAT: See D'ESCLOT.

Escobar y Mendoza, es-kō-baar'ee-men-dō'thaa, ANTONIO: Spanish Jesuit and casuist: b. at Valladolid in 1589. He wrote *Liber Theologiæ Moralis* (1646); *Summula Casuum Conscientiæ* (1626); and other works. The lax morality of his writings was censured by Pascal in some of his *Provincial Letters*. D. July 4, 1669.

Escobedo, -bā'dō, MARIANO: Mexican general; b. in Galeana, Nueva Leon, Jan. 12, 1827; in early life a trader on the frontier. He served as a soldier in the war with the U. S. 1847–48; was prominent in the "reform war" 1858–61, and in the resistance to the French invasion 1862–63; and held out with Juarez until 1864, when he retired to Texas. In Nov., 1865, he inaugurated a new republican campaign in the north by capturing Monterey; advancing in a series of victories, he defeated Miramon at San Jacinto, Feb. 1, 1867, besieged the Emperor Maximilian in Querétaro, and took him prisoner May 14; he ratified the decree of the court martial which condemned Maximilian to death. Promoted to general of division, he was made commander-in-chief of the republican armies. In Aug., 1876, President Lerdo made him Minister of War; on Lerdo's deposition, Nov. 6, 1876, he went into banishment. In Feb., 1878, he tried to enter Mexico, was captured, tried, but exonerated, and in 1880 he again took office under the Government. Since 1883 he has lived in retirement. HERBERT H. SMITH.

Escosura, -soo'raa, PATRICIO, de la: statesman and author; b. in Madrid, Nov. 5, 1807; studied mathematics in Valladolid. In 1824 he was exiled for his connection with the society of the Numantinos, and then studied in Paris and London. On his return to Spain two years later he entered a regiment of artillery, where he was soon promoted to the rank of officer. Twice banished as a partisan of the Carlists (in 1834 and in 1836), he returned to his country in 1846, and became Under Secretary of State in the following year. In 1855 he was sent as especial envoy to Portugal, after which he was Minister of the Interior, and from 1872 to 1874 Spanish ambassador to the German empire. For a long time Escosura was one of the most prominent editors of the *Revista de España*, in which he published a number of articles bearing on Spanish literature and art. He has written several historical works, such as the *Historia Constitucional de Ingleterra* (1859); dramas, such as *Corte del Buen Retiro* (represented in 1837); *Las Mocedades de Hernan Cortés* (represented in 1844); *Roger de Flor, ó los Españoles en Oriente*, an historical tragedy represented in 1846, and published in 1877; and historical novels, such as *Ni Rey ni Roque* (1835) and *El Patriarca del Valle* (1846). D. Jan. 22, 1878. HENRY R. LANG.

Escrow [O. Fr. *escroe*, scrap, shred, loan-word from German; cf. O. H. Germ. *scrōt*, scrap]: a deed or other instrument importing a legal obligation deposited by the grantor or party executing it with a third person, to be delivered to the grantee or obligee on the fulfillment of a certain condition. Until the condition is fulfilled a deed in escrow has no effect as a deed, and the title of the estate remains in the grantor. An escrow takes effect, in general, from the time of the fulfillment of the condition or of the second delivery; and where the second delivery is expressly made necessary to give it effect the delivery will be enforced by a court of equity. In certain cases, where the ends of justice require it, and no injustice will be done, the instrument may, by a fiction of law termed "relation," be referred for its validity back to the first delivery. Revised by F. STURGES ALLEN.

Escuintla, es-kweent'laa: a southern department of Guatemala; bounded N. by Chimaltenango, Zacatepequez, and Amatitlan, E. by Santa Rosa, S. by the Pacific, and W. by Suchitepequez and Solola. Area, 1,950 sq. miles. The northern part is hilly or mountainous, the coast regions generally low; the soil is very fertile, and there are many large sugar and cacao plantations. The department has extensive forests yielding cabinet woods; at Guaymango and Santa Lucia there are interesting Indian antiquities. Pop. (1892) 31,302.—ESCUINTLA, the capital, on the Central Railroad, is important as a central point between Guatemala, San José, Antigua, and Amatitlan; its trade with the surrounding district is large. From December to March it is much frequented by wealthy Guatemalans. Pop. about 6,000.
HERBERT H. SMITH.

Escu'rial, or **Esco'rial** [deriv. of Span. *escoria*, a heap of rubbish from a mine: Ital. *scoria*: Fr. *scorie* < Lat. *scoria*, slag]: a monastery and royal palace near Madrid, in Spain, built by Philip II., and dedicated to St. Lawrence on occasion of the victory of St. Quentin in 1557, on that saint's day. According to the somewhat doubtful tradition, it was built in the form of the gridiron on which that saint is said to have been broiled alive. The work was begun by Juan Bautista de Toledo in 1563, and completed by his pupil, Juan de Herrara, in 1584. The cross-bars of the gridiron are represented by ranges of buildings separated by intervening courts. They were formerly inhabited by monks and ecclesiastics. The main portion of the building is 706 feet long and 550 feet wide. The projection which forms the royal palace is 460 feet in length. The height of the edifice is about 60 feet, and at each angle is a square tower 200 feet high. It is one of the largest and perhaps one of the most tasteless buildings in Europe, though grand from its size. The church in the center of this enormous mass of stone is very large and rich. The Pantheon, a repository beneath the church, is the place of interment for the royal family, whose remains are deposited in tombs of marble placed in niches, one above another. The richest part of this edifice, however, was that which contained pictures by Rubens, Titian, Raphael, Velasquez, and other great masters—the best collection that any place in Europe displayed. The French, when in possession of the Escurial, removed many of these works. The most valuable treasures of the Escurial constitute the collection of ancient manuscripts preserved in the library, especially those of the Arabian writers.

Escutcheon [O. Fr. *escusson*, from deriv. of Lat. *scu'tum*, shield]: in heraldry, a surface, usually shield-shaped, on which heraldic bearings are charged, and which makes up the larger part of the *achievement*. An escutcheon of pretense is the shield on which a man carries the arms of his wife, if she is an heiress and has children. It is placed in the center of his own shield, and is mostly of the same form. An escutcheon is sometimes used as a bearing. See HERALDRY.

Escutcheon, or **The Milk Mirror**: in the Guénon method of selecting milch cows, the shield-like outline upon the back of the cow's udder and the adjacent parts, formed by the upward growth of the hair. Some writers call the whole outline the "mirror," and the upper part only the "escutcheon." The size and perfection of these marks afford valuable means of judging the milking qualities of cows, though much experience is required to make the estimate.

Esdrae'lon, in the apocryphal book of Judith, **Esdrelom** [from the Gr. Ἐσδραήλων, a corruption of the Hebrew *Jezreel*]: the most picturesque, most fertile, and historically most important plain in Palestine, "lying between Tabor and Carmel, and between the hills of Galilee on the north and those of Samaria on the south." In Scripture it is twice (2 Chron. xxxv. 22; Zech. xii. 11) called "the valley (plain) of Megiddo." Jezreel is properly the southeastern part of it, although this name is sometimes given to the whole. It is triangular in form, the length of its southeastern side being about 15 miles, its southwestern about 18 miles, and its northern about 12 miles. Its surface, whose elevation is about 400 feet above the Mediterranean, is slightly undulating. It sends off toward the Jordan three great arms or branches, which are separated from one another by the mountains of Gilboa and Little Hermon. Only one of these arms, however (the middle one), declines eastward. The greater part of the plain is drained by the Kishon, which empties into the Mediterranean near Acre. This great plain has been the scene of several important battles, and with it are associated the names of Barak, Gideon, Saul, Josiah, the crusaders, and Napoleon. See Edward Robinson, *Physical Geography of the Holy Land* (1865).

Es'dras, Books of: certain books of the Old Testament and of the Apocrypha ascribed to Ezra, whose name is Græcized into *Esdras*, following the Septuagint. The canonical books of Ezra and Nehemiah (as they are called in the Authorized English Version) are denominated in the Vulgate and in the Thirty-nine Articles of the Anglican Church the first and second books of Esdras, while the apocryphal books, now generally known as the first and second of Esdras, are there called the third and fourth of Esdras. The Geneva Bible (1560) first adopted the present nomenclature, calling the two apocryphal books first and second Esdras.

The first (apocryphal) book of Esdras was written in very good Greek, but whether in Palestine or in Egypt, and at what time, can not be determined. It has some historical value, and is for the most part a history of the restoration of the Jews after the Babylonian captivity. It is not received into the canon of either Jews or Christians.

The second apocryphal book of Esdras is purely pseudepigraphic, being a record of pretended revelations made to Ezra for the encouragement of the suffering Jews. Many interpolations have been made in it by some overzealous Christian. The original is believed to have been written by a Jew of Egypt in the Greek tongue, either just before or soon after the Christian era. The original Greek is lost, but Latin, Ethiopic, and Arabic versions exist. It is canonical in the Abyssinian Church. English versions are the authorized, from the Latin, Ockley's, from the Arabic (1711), and Laurence's, from the Ethiopic (1820). See these books in Dr. Bissell's volume on the Apocrypha, in the American Lange series. Revised by Willis J. Beecher.

Esk: a small river of Scotland, in the county of Dumfries; flows southward through Eskdale Muir, and enters Solway Firth. Length, about 40 miles. Its valley is noted for picturesque scenery. Another river Esk is formed by the union of the North and South Esk, which meet in Dalkeith Park, Edinburghshire. It enters the Firth of Forth at Musselburgh.

Eskilstuna, es-kil-stoo'naă: town of Sweden; 55 miles W. of Stockholm (see map of Norway and Sweden, ref. 11-F). It is the principal place in the kingdom for the manufacture of the better sorts of iron. Pop. (1895) 12,064.

Eskimauan (es-ki-mō'an) **Indians**: the Eskimos: a linguistic stock occupying the northern coasts of America from Labrador to Mt. St. Elias, also Baffin Land and the shores of Greenland. In their own tongue they are called Inuit, a word meaning "men," while the word Eskimo is said to be an Algonkin term of reproach, meaning "eaters of raw meat." In color they are lighter than their Indian neighbors, and a trifle shorter in stature. Their skulls are hypsicephalic, inclining to dolichocephalic, the hair black and scanty on the body, the hands and feet small, and the faces flat and oval.

The activities and arts of the Eskimo have been evoked by their arctic environment, by the sources of material, by the climate and the movement of game, and by the changing of seasons. Their winter houses are subterranean, built, in the west, of puncheons and whale's bones covered with earth; and in the central region, of snow cut into blocks, and made in shape of a dome. The entrance is by means of a long, low gallery, with a succession of skin doors to exclude the cold. Lamps of stone, filled with blubber and having wicks of moss, afford light and heat, and fire for cooking. In the regions where wood may be obtained a hearth replaces the lamp. Banquettes around the apartment furnish sitting room by day and sleeping-places by night. The number to be accommodated varies with the locality, but in the absence of the strict clan system of social organization, the number of persons in a habitation is always smaller than that which occupied the "long house" of the stocks farther south. In the summer the underground abodes are deserted for tents or temporary shelters that may be easily transported.

The clothing of the Eskimo is made of the skin of such animals or birds as are abundant, from which the fur or feathers are not removed. Men and women are clad alike, in trousers of seal or deer skin, according to the season, and in loose fitting shirt or parka surmounted by a hood, very much enlarged for women with infants. Their feet are shod in sealskin boots, drawn over inner boots or socks of warmest fur. Their dress is ornamented with particolored fur in great taste. Waterproof garments are made of the intestines of seals or from the skins of fish. Tattooing is practiced, and the wearing of labrets is common in the west.

The men are employed chiefly in obtaining the means of subsistence, while the women are occupied in preparing it for use. Their dainty boats or kaiaks for a single hunter are made by stretching prepared sealskins over a frame. The owner sits in the center, and draws his seal-gut parka to the gunwale, where he lashes it in order to exclude the water. Around him on neatly constructed frames, or held in place by spider-lines, are his great harpoon with its line and float; his small harpoon and throwing stick; his paddle and dispatching spear ready at a moment's notice. In this frail bark he ventures on the open waters to hunt the aquatic mammals. A larger open boat, or umiak, is also used in moving from place to place during the summer hunt. Upon the land or over the ice-floe the means of transportation is the sledge drawn by dogs. By this conveyance he takes long journeys, transports his effects from place to place, and brings to his family huge loads of food and furs.

The Eskimo bows are made of bits of horn or antler lashed together, or of brittle wood strengthened with sinew cord laid on in the most ingenious manner to convert a breaking into a columnar strain.

Fishing is done with lines and nets, or with fish-spears. Frequently the nets are set under the ice. The fishing hooks are marvels of workmanship, with their compound barbs, ivory spreaders, and particolored sinkers of stone and ivory. The fish-spears have prongs in form of a double clasp, which are driven upon both sides of the game to secure it.

In manufactures the Eskimos are ingenious. During the long winter days, when they must stay indoors, men carve from ivory, antler, horn and wood objects of use as well as ornament. Buttons and toggles for clothing and harness, harpoon heads, barbs for darts, arrows, and fish-spears, and conveniences for the manipulation of ice and snow and water for household use, are marvels of sagacity. Women spend their time in making garments and tents. Both men and women cover everything which they manufacture with etchings and carvings or embroidery. Among them barbaric art may be seen in full bloom. For these reasons the manufactures of this people have furnished the best explanations for thousands of objects of use and adornment found in remains of ancient peoples in Europe. Between the tribes of each typical area constant intercourse and traffic are maintained, and long journeys are taken to secure wood or soapstone, or harder materials for their implements.

The amusements of the Eskimo are athletic sports and dramatic entertainments, in some of which they excel. Children at their sports mimic the occupations of their elders. Trials of skill and gambling are universal, and an intricate game of dominoes has been developed by them.

The language of the Eskimo is of the polysynthetic type common to all other American stocks.

The social structure of the Eskimo is not sufficiently made out; but the clan system, such as that of the Athapascans or Iroquois, seems not to exist among them. Each fjord or hunting-center is the seat of the village, and frequently a number of these villages are sufficiently near to give rise to a tribe. In each communal house there is a group of families, and often one of the older men is obeyed as a leader. In the winter the community becomes more compact, but in summer it spreads out in groups over the area visited by game and flocks of migratory birds.

The religion of the Eskimo is animistic. All things are ensouled, and spirits innumerable are everywhere. The medium of communication between the laity and the spirit world is the angakok, corresponding to the shaman of Northern Asia and the medicine man of the Indian. He can see into the land of spirits, can summon the powers to consult with him, and even compel them to heal disease and perform other services at his bidding. With myths innumerable, the Eskimo explains the phenomena of the universe. His worship is dramatic, and takes place in a large snow hut or underground casino, erected for the purpose.

Authorities.—J. Ross, *A Voyage of Discovery* (London, 1819) and *Narrative of a Second Voyage in Search of a Northwest Passage* (London, 1835); Parry, *Journal of a Second Voyage for the Discovery of a Northwest Passage* (London, 1824); Hall, *Life with the Esquimaux* (2 vols., London, 1864); Dall, *Alaska and its Resources* (Boston, 1870); H. J. Rink, *Tales and Traditions of the Eskimo* (London, 1875) and *Danish Greenland, its People and its Products* (London, 1877); F. Boas, *The Central Eskimo* (in Sixth Annual Report of the Bureau of Ethnology, pp. 399–669, Washington, 1888); Murdoch, *Ethnological Results of the Point Barrow Expedition* (in Ninth Annual Report of the Bureau of Ethnology, pp. 19–441, Washington, 1892).

O. T. Mason.

Eskimos: See Eskimauan Indians.

Eski Sagra, es'kēe-saa'graă: a town of European Turkey; province of Adrianople; on the south slope of the Balkan Mountains; 70 miles N. W. of Adrianople (see map of Turkey, ref. 3-D). It has manufactures of carpets, coarse linen, and leather. Here are several mineral springs. Great barbarities were perpetrated on the Christian inhabitants here in 1877. Pop. estimated at 20,000.

Eslaba, Sebastian, de: Spanish general; b. at Eguillor, Feb., 1698. He early entered the army, distinguished himself in the service of Philip V., and attained the rank of lieutenant-general in 1738. From 1740 to 1744 he was Viceroy of New Granada, and his term was memorable for his

brilliant defense of Cartagena against the English, Mar.–May, 1741; the fortifications which he constructed in expectation of the English attack were of great strength, and long made Cartagena invulnerable. After his return to Spain Eslaba was made captain-general, and for some years was Minister of War. D. in Madrid, Jan., 1759.
HERBERT H. SMITH.

Eslen: See ESSELENIAN INDIANS.

Esmann, GUSTAV FREDRIK: Danish journalist and dramatic writer; b. in Copenhagen, Aug. 17, 1860. In 1885 he published two short stories (*Gammel Gjæld*), but since that time he has written chiefly plays. Of his dramas may be mentioned *I Provinsen*; *Før Bryllupet*; *Enkemænd*; *Den Kære Familie*; *Magdalene*.

Esmarch, FRIEDRICH: surgeon; b. at Tönnig, Schleswig-Holstein, Jan. 9, 1823: studied at Kiel and Göttingen, and afterward served in the hospital at Kiel. He was active in the Schleswig-Holstein war 1848–50, and in the latter year was made physician superior; in 1857 director of the surgical clinic at Kiel, and in 1860 professor and director of the Kiel hospital. In the war of 1864 he distinguished himself by his excellent work in the hospitals, and when war broke out between France and Germany he was nominated physician-general and consulting surgeon to the army. After the war he resumed his work at Kiel. He has married twice, his second wife being the Princess Henrietta of Schleswig-Holstein. Esmarch's work both as a practitioner and as a medical authority has been remarkable. He discovered and applied with success the method of performing operations upon injured limbs without loss of blood. Among his many important contributions to medical literature may be mentioned *Ueber Resektionen nach Schusswunden* (1851); *Ueber chronische Gelenkentzündung* (1867); *Ueber den Kampf der Humanität gegen die Schrecken des Kriegs* (1869); *Der erste Verband auf dem Schlachtfeld* (1870); *Verband Platz und Feldlazarett* (1871); *Handbuch der Kriegschirurgischen Technik* (1885–86).

Esmeraldas, es-mā-raal'daas: the northwesternmost province of Ecuador; bounded N. E. by Colombia, S. E. by Carchi, Imbabura, and Pichincha, S. W. by Manabi, and W. by the Pacific. Area, 5,364 sq. miles. The surface is hilly rather than mountainous, the highest peaks attaining hardly 2,500 feet; the rivers Esmeraldas and Cayápas, with their branches, form extensive valleys in which the land is open and adapted for grazing; the hills are covered with luxuriant forest. The climate is warm, but exceptionally healthy for the coast region. With great natural advantages, the province is in a very backward condition. Cattle-raising, farming on a small scale, and a little gold-washing are the only industries. Pop. (1892) about 15,000.—ESMERALDAS, the capital, at the mouth of the Esmeraldas river, has about 3,000 inhabitants. See Wolf, *Memoria sobre la geografía y geología de la provincia de Esmeraldas* (Guayaquil, 1879).
HERBERT H. SMITH.

Es'neh, or **Isné** (anc. *Latopolis*): a town of Upper Egypt; on the left bank of the Nile; about 30 miles above Thebes. It has manufactures of blue cotton and pottery; also an active trade with Sennaar and Abyssinia. Here are the ruins of the populous ancient city of *Latopolis*, so called from the worship of the *latus* fish. Among them is a well-preserved portico of a grand temple, with twenty-four beautiful columns standing, and a zodiac on the ceiling like that at Denderah. All the rest of the temple is literally buried, the houses of the modern town standing even upon its roof. In visiting the portico, one goes down as into a deep vault. It was cleared of rubbish by order of Mohammed Ali in 1842. An older temple appears to have been built at Esneh by Thothmes III. of the eighteenth dynasty, but the present edifice dates from the time of the Cæsars. On the river-bank are the remains of a Roman quay. Pop. about 12,000.

Esoc'idæ [deriv. of *Esox*, the typical genus; from Lat. *esox* (*isox*), name of a fish found in the Rhine, probably the pike]: a family of fishes of the order *Haplomi*, containing the true pikes. The body is elongated, with the back and abdomen nearly straight and parallel; the scales are cycloid and of small size, and cover the whole of the body and more or less of the head; the head is oblong, and produced into a broad, depressed, and flattened snout; the mouth is large, and has a deep lateral cleft; the teeth are developed on the jaws, vomer, palatine, and hyoid bones; on the jaws they are enlarged and sharp; the dorsal and anal fins are situated far behind, opposite each other, and higher than long; the skeleton has numerous vertebræ, and the abdominal ones are much more numerous than the caudal (e. g. D. 41–43 + C. 20–21). The family is entirely confined to the northern hemisphere. It is chiefly represented in America, where about five species are known, while in Europe only a single species—and that also common to the two continents—is found. All the members of the family are very voracious, and by the nature of their dentition well adapted for making havoc among their cohabitants of the water. The most notable species of the U. S. are the *Esox masquinongy*, or true mascalonge, which is pre-eminent among the species of the family for the delicacy of its flesh; the *E. lucius*, which is the same as the common pike of Europe; and the *E. reticulatus*, or ordinary pickerel, of the Middle and Eastern States. In Great Britain the name pike is bestowed on the *Esox lucius* as a specific term, as well as a designation implying maturity, while the name pickerel is restricted to the young. In the U. S., however, both these appellations are very diversely applied. See PIKE and PICKEREL. Revised by DAVID S. JORDAN.

Esox lucius.

Esop: See ÆSOP.

Esoteric, es-o-ter'ik [from Gr. ἐσωτερικός, inner, deriv. of εἴσω, ἔσω, within]: designating or pertaining to those doctrines which are designed for the initiated only. The ancient philosophers are supposed to have had a set of mysterious doctrines, which they imparted to their more enlightened and intimate disciples, and other doctrines, more popular, for the benefit of the multitude; the latter are designated as exoteric.

E'sox: a genus of fishes which includes the pikes, and the type of the family of the *Esocidæ* (*q. v.*).

Española: See SANTO DOMINGO.

Espartero, es-paar-tā'rō, BALDAMERO: Duke of Vittoria; b. at Granatula, La Mancha, Spain, Feb. 27, 1792. He was the youngest son of a common cartwright, and on account of feeble health was destined for the Church; but in 1808 he enlisted in the army, became an officer, fought with great distinction in South America 1815–25, and put down the Carlist insurrection (1833–40) by a series of brilliant exploits, for which he was made a general, grandee of Spain, and duke. In 1841 he took the place of the Dowager-Queen Christina as regent during the minority of Queen Isabella, but in 1843 a revolution declared Isabella of age, and Espartero was banished. He took up his residence in England until 1847, when the law of exile was canceled and he returned. From 1854 to 1856 he was Prime Minister, and after the revolution of 1868 he was twice mentioned as a candidate for the vacant throne. D. at Logroño, Jan. 9, 1879.

Espar'to [Span. *esparto*: Fr. *épart* < Lat. *spartum* = Gr. σπάρτος, broom]: a species of grass (*Stipa tenacissima*) growing in Spain, Barbary, etc. It has a very strong fiber, which is used by the Spaniards for making cordage, mats, nets, etc. Large amounts are used in Great Britain in the manufacture of paper. Its culture in the U. S. has been recommended. Esparto, the *halfa* of Algiers, was first used for paper by an Englishman named Routledge, whose patent was issued in 1856. The paper produced is generally of good quality. See FIBER.

Espinasse, de-les'pi-naas', CLAIRE FRANÇOISE, or JULIE JEANNE ÉLÉONORE, de l': conversationalist and letter-writer; b. at Lyons, France, in Nov., 1732; distinguished for her wit and sensibility. In 1752 she went to live in Paris as companion to Madame du Deffand, in whose house she remained nearly ten years. She gained the affection of d'Alembert, and became about 1762 mistress of a *salon* which was frequented by a brilliant literary coterie. D. in Paris, May 23, 1776. Her published letters (1809, 1887) are much admired.

Espinel', VINCENTE: poet and novelist; b. at Ronda, Andalusia, Spain, between 1544–51. Little is known of his life. He left his home very early, living for some years in Italy, and serving later as a Spanish soldier in the Netherlands. In 1591, when, having returned to his native place, he was the incumbent of a benefice, he published a volume of lyric poems (*Diversas Rimas*, Madrid, 1591) in Castilian and Italian meters. His principal work, however, is the romance entitled *Relación de la Vida y Aventuras del Escudero Marcos de Obregon* (1618), the best representative of that type of works of fiction in the seventeenth century which arose from the combination of the picaresque romance with the Italian novel. It is well known that Le Sage borrowed from Espinel's work a number of incidents of his novel *Gil Blas*. D. in Madrid, Feb. 4, 1624.

HENRY R. LANG.

Espinhaço, es-peen-yaa'sō, SERRA DO: a chain of mountains in Eastern Brazil, properly a branch of the Serra da Mantiqueira, and forming part of the great coast-range system. It lies E. of and parallel to the river São Francisco, extending from lat. 20° S. to about lat. 10° S., the trend being a little E. of N. The highest peaks are Caraço, near Ouro Preto (5,750 feet), Itacolumí, Piedade, and Itambé, from 4,800 to 5,200 feet. H. H. S.

Espinosa, GASPAR, de: Spanish lawyer and soldier; b. at Medina del Campo about 1475. In 1514 he went to America with Pedrarias as *alguazil mayor* or chief justice of the Darien colony. The charges against Balboa were tried before him, and later he presided over the court at Acla, where Balboa was condemned to death. He refused to pass sentence until ordered to do so by Pedrarias. Espinosa led many expeditions in search of gold and Indian slaves, notably one in the Nombre de Dios region (1516), when he recovered a large amount of treasure taken from Gonzalo de Badajos by the Indians. Espinosa treated the Indians with great cruelty. In 1518, acting for Pedrarias, he founded Panama. Returning to Spain some years later, he was appointed to take the *residencia* of the auditors of Santo Domingo, where it appears he afterward lived, though he frequently visited Panama. He was the real financial partner in Pizarro's second expedition to Peru (1526), though the priest Luque appeared for him. When Pizarro called for aid against the uprising of the Indians under Manco, Espinosa hurried to Lima with 250 soldiers. When he arrived Pizarro and Almagro were preparing for war on each other. Hoping to reconcile them, Espinosa went to Cuzco to see Almagro, but died a few days after his arrival (Aug. or Sept., 1537). HERBERT H. SMITH.

Espirito-Santo: a state of Southeastern Brazil; bounded N. by Bahia, E. by the Atlantic, S. by Rio de Janeiro, and W. by Minas Geraes. Area, 17,310 sq. miles. Except Sergipe, it is the smallest of the Brazilian states. It lies almost entirely in the region of the Brazilian coast range, but the mountains are not so high as those of the neighboring province of Rio de Janeiro. They take various local names, as the Serra dos Puris in the S., and in the northern part the Serra dos Aymorés, which appears to be the culminating group. The rivers Doce, Mucury, Guarapary, and others are bordered by lower and often very fertile land, and along the coast there are regions of swamps and small lakes. The greater portion of the surface is still covered with heavy forest, and the cutting and export of rosewood and other cabinet woods form one of the principal industries. The most important agricultural products are coffee and sugar. Espirito-Santo was one of the original Portuguese captaincies ceded to Fernandes Coutinho, and settled by him in 1535. It progressed slowly owing to the poverty or lack of enterprise of the early governors, and it is still one of the most backward regions in Brazil. Estimated pop. (1893) 132,092. The capital and principal port is Victoria; São Matheus, Guarapary, and Itapemirim are small towns. See Hartt, *Geology and Physical Geography of Brazil* (1870), chap. ii.; Bazilio Carvalho Daemon, *Provincia do Espirito-Santo* (1879). HERBERT H. SMITH.

Esprits Forts [Fr., bold spirits]: a school of advanced thinkers in France, numbering among them Voltaire, Diderot, d'Alembert, and Helvétius. They opposed the doctrines and practices of the Church, and wished to substitute the worship of reason. See FREE-THINKERS.

Espronceda, es-prōn-thā'daa, JOSÉ, de: poet; b. in Estremadura, Spain, in 1810; perhaps the best representative of Byronic romanticism in that country. His restless life began with imprisonment at the age of fourteen for belonging to a revolutionary society, Los Numantinos. After his release from the convent where he was confined he found it wise to leave Spain, and so wandered to Lisbon, London, and Paris. In Paris he fought at the barricades in 1830. He enrolled himself among the volunteers to free Poland from Russia. Returning to Spain, he lived in the midst of republican and revolutionary plots until his premature death, May 23, 1842. He left behind him portions of two narrative poems, *Pelayo* and *El diablo mundo*; a novel, *Sancho Soldaña*; and a limited number of lyric poems of great power and beauty. See his *Obras poeticas* (Paris, 1870); *Páginas olvidadas* (Madrid, 1882). A. R. MARSH.

Es'py, JAMES POLLARD: meteorologist, sometimes styled the "storm-king"; b. in Washington co., Pa., May 9, 1785; graduated at Transylvania University in 1808, subsequently studied law and practiced for four years in Xenia, O. In 1817 he removed to Philadelphia to take charge of the classical department of the Franklin Institute. He was the author of a theory of storms which excited some controversy, and which he published in 1841, in systematic form, under the title *The Philosophy of Storms* (Boston and London, 1841). According to this theory, every great atmospheric disturbance commences with the uprising of a body of air which has been rarefied by heat. The heavier air, flowing in beneath, creates currents converging from all directions to the central point. The rising mass dilates as it rises, in consequence of diminished pressure, and its temperature falls, in consequence of this dilatation, down to the dew-point and below, precipitating its contained vapor in the form of cloud. The latent heat of elasticity thus liberated dilates the air still more, and disturbs the equilibrium anew, so that the rising continues to go on, till the moisture in the air forming the upward current is practically exhausted. As the heavier air flowing in beneath finds a diminished pressure above it, this air also rises, causing still greater draughts upon the surrounding air, and establishing permanent converging currents, which meet in the center and rush upward, with constantly increasing violence. The vast amount of aqueous vapor precipitated during this atmospheric commotion gives rise to heavy rains. Espy's theory found many adherents. The physical principles on which it rests are sound, and it is so far supported by observation. It received also the approval of the French Academy of Sciences in a formal report. But his views as to the mechanics of storms are untenable, and are contrary to observed facts. Converging currents invariably produce rotation, and hence, though storms doubtless often originate in the causes assigned by him, their characteristic action is rotatory or spiral. The rotatory theory is now generally accepted, and has given to meteorology the familiar term *cyclone*.

Espy entertained a sanguine belief that rains could be brought on at any time by means of great fires, kept up long enough and over a sufficiently large surface to initiate a powerful upward movement, relying on natural causes to maintain the current when once started. He even supposed that it might be possible in this way to maintain the navigation of the upper Ohio river through the dry season. He therefore petitioned Congress and the Legislature of Pennsylvania to make a sufficient appropriation to enable him to try the experiment, but without success. He received, however, an appointment as meteorological observer under the Government; and while holding this position he made arrangements, in accordance with a judicious suggestion of the Hon. A. H. Stephens of Georgia, with the press and with the various lines of telegraph converging to the capital, to publish daily bulletins of the state of the weather in different and distant localities. These were doubtless the first weather-telegrams ever regularly made public. The system, discontinued during the civil war, was subsequently revived and largely extended. D. in Cincinnati, Jan. 24, 1860.

Esquimault, or **Esquimalt**: a harbor and British naval station on the southeast end of Vancouver Island; 3 miles W. of Victoria, capital of British Columbia (see map of Canada, ref. 8–D). It is strongly fortified, is a naval arsenal, and is connected by rail with the coal mines of Nanaimo. It is a safe and excellent anchorage for ships of any size, has a fine graving dock, and is the rendezvous of British warships on the Pacific coast of North America. M. W. H.

Esquimaux: the ESKIMAUAN INDIANS (*q. v.*).

Esquirol, es'kēē'rol', JEAN ÉTIENNE DOMINIQUE, M. D.: physician and philanthropist; b. at Toulouse, France, Jan. 4, 1772. He founded at Paris in 1799 an asylum for the insane, which was a model institution, and he initiated a reform in the treatment of the insane. In 1817 he began a course of clinical lectures for mental maladies, on which he wrote a valuable work, *Des Maladies Mentales* (2 vols., 1838). He became in 1826 chief physician of the asylum at Charenton. D. Dec. 12, 1840.

Esquiros, es'kee'rōs, HENRI ALPHONSE: a poet and novelist; b. in Paris, France, in 1814. On account of his work, *L'Évangile du Peuple* (The Gospel of the People), he was in 1840 sentenced to eight months' imprisonment, during which time he became an intimate friend of Lamennais. After the revolution of 1848 he was elected a member of the Legislative Assembly, in which he belonged to the Extreme Left. In consequence of the *coup d'état* of 1851, he had to leave France, and lived in England until 1869, when the amnesty proclaimed by Napoleon allowed him to return. Soon after he was elected a member of the legislative body. After the overthrow of the empire, in Sept., 1870, the provisional government sent him as administrator-general of the department of Rhône to Marseilles, where he succeeded in suppressing anarchical tendencies. He favored the separation of the south of France from the north, and for a while refused to recognize the decree of Gambetta which suspended him, but finally resigned in Nov., 1870, in order to avoid a civil war. In Feb., 1871, he was elected a member of the National Assembly, and took his seat with the Extreme Left. He published, besides other works, *Le Magicien* (1837); *Charlotte Corday*, a novel (1840); *L'Évangile du Peuple* (1840); *L'Histoire des Montagnards* (1847); *La Morale Universelle* (1859); *L'Angleterre et la vie anglaise* (5 vols., 1859–70); and in the English language, *Religious Life in England* (London, 1867). D. at Versailles, May 10, 1876.

Esquivel, es-kē̆e-vel', JUAN, de: Spanish soldier, conqueror of Jamaica; b. about 1470. He went to Hispaniola with Ovando in 1502, and commanded the Spanish troops in the province of Higuay during the struggle with Cotabanama, 1504–05. In 1509 Diego Columbus sent him to conquer and colonize Jamaica; he easily reduced the Indians to submission, founded a colony, and governed it with wisdom and success. D. in Jamaica about 1519. H. H. S.

Ess, LEANDER (his convent name, properly JOHANN HEINRICH), van: Roman Catholic theologian; distinguished at once for his learning and his liberality of opinion, especially with respect to the circulation of the Scriptures: b. at Warburg, in Westphalia, Germany, Feb. 15, 1772. In 1790 he entered the Benedictine monastery of Marienmünster in Paderborn, in 1796 became priest, and his monastery being secularized in 1802, pastor at Schwalenberg, and from 1813 till 1822 was Professor Extraordinary of Theology at Marburg. He aided his cousin, Karl van Ess (1770–1824), in publishing a German translation of the New Testament (1807), and in 1840, without assistance from his cousin, who had meanwhile given up his liberal opinions, published also a translation of the Old Testament. His edition of the Vulgate appeared in 1822, and his edition of the Septuagint in 1824. He lived in literary seclusion for several years, and died at Affolderbach, Oct. 13, 1847. His library, rich in Bibles, patristic, mediæval, and Reformation literature, and comprising over 13,000 volumes, now belongs to the Union Theological Seminary in New York city.

Es'segg, or **Es'sek** (anc. *Mur'sia* or *Mur'sa*): a strongly fortified town of the Austro-Hungarian monarchy; capital of Slavonia; on the river Drave, 13 miles from its entrance into the Danube, and 150 miles S. by W. from Budapest (see map of Austria-Hungary, ref. 8–G). It has a prosperous trade, facilitated by the steam-navigation of the river, and contains an arsenal, a town-house, and a normal school. Pop. (1890) 19,600.

Essele'nian Indians: a distinct linguistic stock of North American Indians, comprising only the Eslen (Escelen, Eclemach, etc.) tribe formerly inhabiting a narrow strip along the coast of California, from Monterey Bay southward to the vicinity of Santa Lucia Peak. Their habits and customs differed somewhat from those of the tribes of Costanoan and Salinan stocks bounding the Esselenian territory on the north and south respectively. The distinctness of their language is sufficiently determined by what is known through investigation among the Rumsen, a Costanoan tribe with whom the Eslen intermarried, and through the study of short vocabularies gathered by Lamanon in 1786 and Galiano in 1792. The names of nineteen of the villages formerly occupied by the Eslen are known, nearly all of them having been connected with the San Carlos mission.

AUTHORITIES.—*Voyage de La Pérouse*, p. 288 (Paris, 1797); Galiano, *Relación del viage hecho por las Goletas Sutil y Mexicana* (Madrid, 1802); H. H. Bancroft, *History of California*, i–vii. (San Francisco, 1884–90); H. W. Henshaw, in *American Anthropologist* (Washington, Jan., 1890). See INDIANS OF NORTH AMERICA. F. W. HODGE.

Es'sen: a town of Rhenish Prussia; on the Cologne and Minden Railway, and near the river Ruhr; 27 miles by rail N. E. of Düsseldorf (see map of German Empire, ref. 4–C). It has a cathedral, a gymnasium, a Realschule, and an asylum for deaf-mutes; also manufactures of steam-engines, firearms, woolen cloth, paper, and iron wares. It derives its prosperity chiefly from the rich coal mines which surround it. Here are Krupp's steel-foundries, the largest in the world, employing 15,000 men. Pop. (1890) 78,723; (1900) 118,863.

Essen, HANS HENRIK, Count of: a Swedish general; b. in West Gothland in 1755. He was appointed governor of Stockholm in 1795, and obtained in 1807 the command of an army with which he defended Stralsund against the French. He was sent as ambassador to Paris by Charles XIII., who became king in 1809, and the result of the negotiation was the restoration of Pomerania to Sweden. In 1814 he was raised to the rank of field-marshal and Governor-General of Norway. D. July 28, 1824.

Essenes, es-seenz', or **Essæans**: the latest, and apparently the smallest, of the three Jewish sects in existence in the time of Christ. They are not mentioned in the New Testament. The etymology of the name is doubtful, and the history of the sect obscure. The Essenes were mystics, and most of them celibates. They are not to be confounded with the Therapeutæ, although a kindred sect. The greater part of them lived by themselves near the northwest shore of the Dead Sea, but they were also scattered in various parts of Palestine, and are supposed to have numbered in all some 4,000 or 5,000. The first distinct trace of them is about 110 B. C., and they disappear from history after the destruction of Jerusalem by the Romans. See C. D. Ginsburg, *The Essenes* (London, 1864), and the article in J. B. Lightfoot's commentary on *Colossians*, pp. 82–179. See also JEWISH SECTS.

Essential Oils [so called because they were formerly supposed to contain the essence or active principle of the plant or substance from which they are extracted], called also **Volatile Oils**: a large class of compounds, mostly of vegetable origin, though some are derived from animal sources. They mostly exist already formed in plants. With a few exceptions they are colorless, and have in most cases a powerful odor and pungent taste, resembling that of the plant whence they are derived. A large number of them are isomeric (or identical in composition) with oil of turpentine and with caoutchouc. These are called terpenes ($C_{10}H_{16}$); others are aldehydes; still others appear to be compounds of alcohol radicals with organic acids, etc. A very few contain sulphur. Most of them are obtained by distillation with water, others by pressure. They are in many cases changed by time and exposure into resins, or resolved into several distinct substances.

Essequibo, es-se-kee'bō: the largest river of British Guiana, rising in the Acaraí Mountains, 41 miles N. of the equator, and flowing, in general, northerly to the Caribbean Sea; length, about 625 miles. Except in the last 50 miles of its course it is much obstructed by rapids and falls. The mouth is an estuary 15 miles broad, but dangerous for navigation owing to numerous islands and sand bars. The lower Essequibo was originally bordered by forests, now largely cleared for sugar-cane plantations; all the middle course is still lined with heavy forest growth, but the upper river flows through open land. The Rupununi, a western branch of the Essequibo, is 220 miles long. Venezuela claims the Essequibo as her eastern boundary, but a large region W. of the river is in the possession of the British.

HERBERT H. SMITH.

Essex (East Saxons): a county of England; bounded E. by the North Sea and S. by the estuary of the Thames. Area, 1,542 sq. miles, of which nine-tenths are arable. It is drained partly by the Stour, the Lea, and the Chelmer rivers. The surface is pleasantly diversified, except the flat marshy land near the sea. The soil is mostly a fertile loam, which produces wheat, barley, oats, beans, hops, potatoes, etc. Essex is an agricultural county, with few manufactures. Many sheep are raised. The chief towns are Chelmsford (the capital), Colchester, Harwich, and Maldon. Essex was a kingdom of the Anglo-Saxon heptarchy, which comprised Essex and parts of Middlesex, Hertford, and Bedford. Pop. (1901) 816,524.

Essex: town; Middlesex co., Conn. (for location of county, see map of Connecticut, ref. 11–I); on railway and on the Connecticut river, 7 miles from its mouth, and about 17 miles W. of New London. It has manufactures of carriages and soap. Pop. of township (1880) 1,855; (1890) 2,035; (1900) 2,530.

Essex: town (incorporated in 1889); Essex co., Ontario, Canada (for location of county, see map of Ontario, ref. 6–A); on railway; 15 miles S. E. of Windsor. It has five churches, high school, creameries, sawmills, cooperage, cabinet-works, and manufactures of engines, boilers, and agricultural implements. Pop. (1881) 800; (1891) 1,709.

EDITOR OF "FREE PRESS."

Essex, ROBERT DEVEREUX, Second Earl of: English courtier; b. near Bromyard, Herefordshire, Nov. 10, 1567; eldest son of Walter, the first Earl of Essex. He was educated at Cambridge; graduated in 1581, and was one of the most learned noblemen of the age. He served with distinction at the battle of Zutphen. In 1587 he was made master of the horse, and after the death of Leicester, in 1588, he became the declared favorite of Queen Elizabeth. He had a handsome person, agreeable manners, and possessed the art of ingratiating himself. He married, in 1590, Sir Philip Sidney's widow, who was a daughter of Sir Francis Walsingham. He commanded the land forces of the expedition which took Cadiz in 1596, and was made earl-marshal of England in 1597. He was appointed Lord-Lieutenant of Ireland, and was sent in 1599 to subdue a revolt of the Irish, but was not successful. He was removed from office, deprived of all the honors the queen formerly had showered upon him, and ordered not to leave his house. In despair, he made an attempt to excite the population of London to rise in his favor, but the attempt failed utterly. In the straits caused by these acts, Bacon acted as his friend, but, nevertheless, Essex was tried for treason, and beheaded Feb. 25, 1601. He was brave and generous, but impetuous and imprudent.

Essex, THOMAS CROMWELL, Earl of: See CROMWELL.

Essex Junto, The: a name first applied by John Hancock about 1781 to a group of political leaders who lived in Essex co., Mass., or had business connections there. The interests of this section were commercial, so that the Essex Junto became the personification of the desire of the commercial interest for a stronger federal union. Prominent members of the Junto were George Cabot, the Lowells, Timothy Pickering, Theophilus Parsons, Stephen Higginson, and Benjamin Goodhue, while Fisher Ames sympathized with them strongly. The Junto naturally joined the Federalists and became the extreme wing of that party. On the succession of Adams the members of the Junto followed Hamilton. On two occasions the faction attracted special notice. At the time trouble was threatened with France, President Adams tried to throw upon the Essex Junto the responsibility for the "war scare," and denounced them as a British faction. When opposition to the "restrictive system" (see EMBARGO) arose in New England, the name "Essex Junto" became a synonym for New England federalism. It was vaguely but wrongfully believed that behind this lurked a spirit of disloyalty, of which the alleged intention to secede in 1808, the Hartford convention, etc., were supposed manifestations. C. K. ADAMS.

Essipoff, ANNETTE: See the Appendix.

Ess'ling: village of Austria: on the Danube; 7 miles E. of Vienna; the scene of an indecisive battle between Napoleon and the Austrians in May, 1809. See ASPERN.

Es'slingen: town of Würtemberg; on the river Neckar; 9 miles by rail E. S. E. of Stuttgart (see map of German Empire, ref. 7–D). It is on the railway which connects Stuttgart with Ulm, is still partly surrounded by walls, and has an old castle. It has a splendid Gothic church, built in 1440, with a spire 246 feet high, a handsome town-hall, and a richly endowed hospital. Here are important manufactures of machinery, cotton and woolen stuffs, paper, silverware, and wine. Esslingen was founded in the eighth century, and became in 1209 a free city of the German empire, and in 1802 a part of the duchy of Würtemberg. Pop. (1890) 22,156; (1895) 24,031.

Essonite (cinnamon-stone): See GARNET.

Estado Oriental: See URUGUAY.

Estaing, des'tăn', CHARLES HECTOR, Count d'; naval officer; b. in Auvergne, France, in 1729. He served in the army in India, 1757, and was appointed lieutenant-general of the naval forces in 1763. But the hostility excited among naval officers whose hopes were destroyed or whose pride was stung by the appointment to such high rank of one who was educated for the land service placed him in an unfortunate position, which his want of discretion rendered still worse. He commanded as vice-admiral a fleet sent in 1778 to fight for the U. S. His fleet was damaged by a storm near Newport in August of that year. He soon repaired his ships, and sailed to the West Indies, where he captured Grenada in 1779, displaying great bravery in the attack. In September of that year he attacked the British at Savannah, without success. He returned to France in 1780, and afterward devoted himself to politics. In the Revolution he supported the king and queen with a fidelity and zeal that finally cost him his life. He was guillotined Apr. 28, 1794.

Estate [from O. Fr. *estat* (> Mod. Fr. *état*): Ital. *stato*: Span. *estado* < Lat. *status*, condition, state]: a word sometimes used to indicate property generally, whether real or personal. Sometimes it includes land alone. In law it denotes the interest which one may have in property. It means the time during which ownership exists, as for a year, or for life, or forever. Under the common law, estates in land are divided, as regards the *quantity* of interest, into two general divisions, freehold estates and estates less than freehold.

A *freehold* is an estate which may last for life or longer. An estate which is circumscribed within a certain number of years, or one in which the possessor has no fixed right of enjoyment, is less than freehold, and although, in fact, it may endure longer than the life of its first possessor, still the law regards it as a lower estate than a freehold; it is in the eye of the law personal property, and does not descend to heirs, though it may pass to executors or administrators.

Freehold estates are divided into estates of inheritance, which pass to heirs, and estates not of inheritance; the former are again divided into estates in fee simple and estates in fee tail. A fee simple is the most extensive and highest interest a man can have in land. If not aliened or devised, it passes to heirs generally. A fee tail, on the other hand, is an estate which is limited to certain particular heirs or to a certain class of heirs, to the exclusion of the others, as to the heirs of one's body, which excludes collateral heirs, or to the heirs male of one's body, which excludes females. Fee tails have had only a limited existence in this country, and are now, in general, abolished. In New York, by the law of 1782, they were changed into estates in fee simple.

Freeholds not of inheritance are for life only, either for the life of the tenant or of some other person or persons, when the estate is called an estate *pur autre vie*. Life estates are created by the act of the parties or by operation of law. An example of the former is where A conveys land to B for the term of his natural life, or where A conveys land to B without expressing the duration of the term. Here, under the common law, B would take only a life estate, but by statute in New York and many other States a grant or devise of real estate passes all the interest of the grantor or testator, unless the intent to pass a less estate or interest appears in express terms or by necessary implication. Curtesy and dower are life estates created by act or operation of law. When a man marries a woman seized at any time during the coverture of an estate of inheritance, and has issue born alive during the life of the wife, which might possibly inherit from the mother, the husband on the death of the wife has an estate for his life in her land, which is termed curtesy. In many of the U. S. a wife may alien or devise her land so as to defeat this estate, and in some it is altogether abolished. When a husband dies, the wife has a life estate in a third of all the land in which at any time during coverture he had an estate of inheritance. This estate of the wife is termed dower. In some of the States, by statute, a wife is entitled to dower only in the land of which her husband died seized, and in most of the States the interest which a wife takes in the land of her deceased husband has been a matter of statutory regulation.

Estates less than Freehold.—These are divided into estates for years, at will, and by sufferance. An estate for years is an estate for a determinate period, whether it be for a longer number of years than a human life, or for only a portion of one year. An estate at will is where one man lets land to another to hold at his will, as well as that of the lessee. Such an estate is terminated by either party on due notice. Out of estates at will a class of estates has grown up called estates from year to year, which can be terminated only by six months' notice, expiring at the end of the year. An important element in creating this estate is the payment of rent. An estate by sufferance arises when one comes into the possession of land by agreement, and holds over after his original estate has expired, and without any agreement, express or implied, by which it is continued. The landlord has a right to enter at any time, and dispossess the occupant without notice.

These estates may be created upon condition—that is, their existence may depend on the happening or not happening of some event whereby the estate may be created, enlarged, or defeated. A fee, a freehold, or a term for years may thus be upon condition. The condition must either be precedent—that is, must happen before the estate can vest or be enlarged—or subsequent, when it will defeat an estate already vested.

Estates may also be legal or equitable. They are called "equitable" when the formal ownership is in one person and the beneficial ownership is in another. Another form of expression is that a trust is created. This distinction does not affect the nature of the estate. Thus a trust estate may be a life estate or a fee, and in the latter case is transmissible to heirs as though it were a strict legal estate.

In regard to the time of enjoyment, estates are divided into estates in possession and estates in expectancy. An estate in possession is one in which there is a present right of enjoyment. Estates in expectancy are those which give either a vested or contingent right of future enjoyment. They are subdivided into remainders, which are created by the express words of the parties, as where one gives a life estate in land to A, and the remainder to B; and reversions, which arise by operation of law, as where one gives an estate for life to A; here, on the death of A, the estate reverts to the grantor or his heirs, who, until the termination of A's estate, are said to have a reversion in the land. Besides these, there are future estates introduced into the law by the doctrine of uses (see USES) which are not governed by the technical rules applicable to remainders. They are called "springing and shifting uses." Similar provisions in a will are termed "executory devises."

In regard to the number of owners, estates are divided into estates in severalty, in joint tenancy, in common, and in coparcenary. An estate in severalty is one which has only a single owner. An estate in joint tenancy is an estate owned jointly by two or more persons, whose title is created by the same instrument. The distinguishing characteristic is the right of survivorship. On the death of any tenant his interest is extinguished, and the estate goes to the survivors. By the common law, where an estate is conveyed to two or more persons without indicating how it is to be held, it is understood to be in joint tenancy. But in most States of the U. S. this rule has been changed by statute, and persons to whom an estate is conveyed or given take as tenants in common, unless they hold as trustees. An estate in common is where separate and distinct but undivided interests in land are held by two or more persons. Each tenant is considered as solely seized of his share, which on his death descends to his heirs. An estate in coparcenary is the estate which female heirs take in the land of an intestate ancestor. In the U. S. this estate is essentially extinguished, and heirs take as tenants in common.

The English classification of estates in land has been much modified by statute in the U. S., but it forms the basis of the law of real estate everywhere, except in Louisiana, where the civil law prevails. T. W. DWIGHT.

Estates, The Three, or the **Estates of the Realm**: the three classes of feudal society: 1, the nobles; 2, the clergy; and 3, the commons, including the bourgeois or middle class of towns and the peasantry. The term "estates of the realm" was used in Scotland before the Union (1707) as synonymous with Parliament. It consisted of lords spiritual (or mitered clergy), lords temporal (including the nobles and the commissioners of shires and stewartries), and the representatives, called burgesses or commissioners, of royal burghs. They met in one assembly, and usually voted in a body. The "States General" of France were rarely convened after the fourteenth century, and had little or no legislative power. One of the exciting causes of the French Revolution was the dispute which arose in 1789 between the "third estate" (*tiers état*), or bourgeois, and the nobles and clergy, as to whether the third estate had a right to sit with the first and second. In Sweden there were four estates—nobles, clergy, bourgeois (middle class), and peasants, each sitting in a separate house; but since 1865 there are but two legislative houses, both representative. A convention of the States General was long (1580–1795) the supreme power in the Dutch republic.

Es'te (anc. *Ates'te*): a town of Italy; in the province of Padua; picturesquely situated on the slope of the Euganean Hills; 18 miles by rail S. S. W. of Padua (see map of Italy, ref. 3–D). Here is a fine feudal castle, or *Rocca*, belonging to the noble family of Este; also an interesting Romanesque church with a leaning tower. Este has manufactures of silk goods, hats, and earthenware. Pop. 9,000.

Este: an ancient sovereign family of Italy, from which the monarchs of Great Britain are descended. Among the first princes of this family was Oberto I., who married a daughter of Otho, King of Italy, and died about 927 A. D., leaving a son, Oberto II. The family received several districts and towns to be held as fiefs of the German empire. Albertazzo II., who succeeded Oberto II. about 1020, married a German princess of the house of Guelph or Welf. Their son, Guelph IV., received in 1071 the investiture of the duchy of Bavaria. He was the ancestor of the houses of Brunswick and Hanover.

Estella, es-tel'yăă: city of Spain; province of Navarre; 22 miles S. W. of Pamplona (see map of Spain, ref. 12–G). It is well built, and has a church with a lofty tower, a college, and a hospital; also manufactures of linen and woolen fabrics, brandy, and earthenware. Pop. (1887) 5,974.

Estepa, es-tā'păă (anc. *Astepa*): town of Spain; province of Seville; 60 miles E. S. E. of Seville (see map of Spain, ref. 19–D). It has a church which is a noble specimen of Gothic architecture, and a fine palace; also manufactures of baize, oil, etc. Marble is quarried in the vicinity. Pop. (1887) 9,059.

Estepo'na: town of Spain; province of Malaga; on the Mediterranean; 25 miles N. E. of Gibraltar (see map of Spain, ref. 20–D). It has an old Roman castle, is well built, and has extensive sardine-fisheries. Pop. (1887) 9,771.

Esterhazy de Galantha, es-ter-haa'zē-dă-găă-laan'tăă, NICHOLAS, Prince: Austrian diplomatist; b. Dec. 12, 1765; obtained the military rank of field-marshal. He was employed as ambassador to Paris, London, and St. Petersburg between 1801 and 1816. He owned an immense fortune, and founded a rich collection of paintings in Vienna. D. at Como, Nov. 25, 1833.

Esterhazy de Galantha, PAUL, Prince: general; b. Sept. 8, 1635; became a field-marshal in the Austrian army before the age of thirty, and was chosen Palatine of Hungary in 1681. In 1686 he took Buda from the Turks, and in 1687 was created a prince of the empire. D. Mar. 26, 1713.

Esterhazy de Galantha, PAUL ANTONY, Prince: diplomatist; b. Mar. 10, 1786; son of Nicholas Esterhazy de Galantha; was ambassador from Austria to London in 1815–18, and again in 1830–38. In Mar., 1848, he became Minister of Foreign Affairs in the liberal ministry of Hungary, but he resigned about the time the war broke out, and took no part in the conflict. He owned more land than any other subject of the Austrian empire, and had a fine palace at Eisenstadt. D. May 21, 1866.

Esther, es'ter (star), the Persian name of **Hadas'sah** (myrtle): a beautiful Jewish maiden who became the queen of Xerxes, King of Persia (B. C. 486–465). She was a cousin and foster-daughter of Mordecai, the Benjamite, who became prime minister of Persia in place of Haman the Amalekite.

Esther, Book of: one of the latest of the canonical books of the Old Testament, consisting of ten chapters, and relating events which gave rise to the Jewish feast of Purim. The Jews call it emphatically *Megillah*, the Roll. The whole of it is read in Jewish synagogues every year at the feast whose origin it explains; and still, in many synagogues, with noisy demonstrations, such as hissing, and clapping of hands, and stamping of feet at the mention of Haman's name. The inspiration of the book and its right to a place in the canon have been sharply questioned. Much account is made of the singular fact that the name of God does not once occur; that, although fasting is spoken of, no mention is made of prayer; and that the religious tone of the book throughout is low. On the other side, it is urged that the providence of God is magnified; that we have a vivid picture of manners and morals at the Persian court; and, above all, a most valuable exemplification of the unspiritual character of that portion of the Hebrew people who chose not to return to the Holy Land. Its author is unknown. See the commentaries by the Lowell Hebrew Club (ed. Haley, Andover, 1885); by Paulus Cassell (Eng. trans. Edinburgh, 1888); and by Oettli in Strack u. Zöckler's *Kgf. Kommentar z. d. heil. Schriften A. u. N. Test.* (Munich, 1889).

Esther, Apocryphal Book of: the ten canonical chapters of the book of Esther, with interpolations here and there, and the addition of six chapters at the end. These additions are found in the Septuagint, and in versions made from it, but not in the Hebrew. For this reason Jerome placed them together at the end of Esther, but Luther was the first to place them in the Apocrypha. The object of the unknown author was to give a more religious tone to the book of Esther than it originally possessed. Though considered spurious by all Protestant churches, the Greek, Armenian, and Roman Catholic Churches accept these additions as canonical.

Es′therville: city; capital of Emmet co., Ia. (for location, see map of Iowa, ref. 2–E); pleasantly situated on the east branch of the Des Moines river, and Burlington, Cedar Rapids and Northern Railroad. It has superior educational advantages, a fine school-house, a machine-shop, two large flouring-mills, flax-mill, etc. Principal business, farming and stock-raising. Pop. (1880) 138; (1890) 1,475; (1900) 3,237.

EDITOR OF "EMMET COUNTY REPUBLICAN."

Estho′nia (Germ. *Esthland*): a government of Russia, and one of the Baltic provinces; bounded N. by the Gulf of Finland, E. by St. Petersburg, S. by Livonia, and W. by the Baltic Sea. Area, 7,817 sq. miles. The surface is generally flat, and extensively covered with forests of pine; the soil is sandy, and in some parts marshy. The staple products are grain, hemp, flax, tobacco, and cattle. The population of the towns and the nobility are predominantly German, while the people of the rural districts are mostly Esthonians, belonging to the Finnish race. Ninety-six per cent. of the population belong to the Lutheran Church. The language of the Esthonians is soft and melodious, comprising two dialects—the Dorpat, or Werra, and the Reval Esthonian—which differ so greatly that they can not well be treated in the same grammar. The Reval dialect is used in their literature, which consists chiefly of poems, the most important of which is the epic poem *Kalewipoeg*. The Esthonian tribe inhabits also a part of Livonia, with an aggregate population of about 600,000. Esthonia was conquered from the Swedes by Peter the Great in 1710. Capital, Reval. Pop. (1889) 392,738; (1897) 413,724.

Estivation [from Lat. *æstiva're*, pass the summer]: the summer sleeping of animals which, like the African mudfish (*Protopterus*) and some mollusks, lie dormant during hot weather; contrasted with *hibernation*. F. A. L.

Estop′pel [from O. Fr. *estoupail*, deriv. of *estouper* (> Mod. Fr. *étouper*), to stop up, calk, *estoupe* (> Mod. Fr. *étoupe*), tow, oakum: Ital. *stoppa*: Span. *estopa* < Lat. *stuppa*, tow, oakum]: a principle of law whereby one is bound by his previous admission or declaration—not on the ground that it is true, but because to dispute it is regarded as contrary to sound policy, or as subversive of the ends of justice. Estoppels are of record, of deed, and *in pais*.

Estoppel of Record.—By record is here meant the record of a tribunal of a judicial character. No one is permitted in a legal proceeding to contradict an admission made by him in his pleading. So the judgment of a court of competent jurisdiction is in most instances absolutely unimpeachable. If the judgment is *in rem*.—that is, if it determines the status of a person or thing—it is binding on all persons, whether rendered by a domestic or a foreign tribunal. If the judgment is *in personam*, it is conclusive if rendered by a domestic court, and the better opinion is that the same rule applies to a foreign judgment, unless it be shown in either case that the court which pronounced it did not acquire jurisdiction, or that the judgment was obtained by fraud. This respect for the decisions of foreign tribunals is based on the comity which nations show each other, and on the necessities of commerce. The Constitution of the U. S. provides that full faith and credit shall be given in each State to the public acts, records, and judicial proceedings of every other State. Under this provision the judgments of the courts in one State are binding on the tribunals of another State, without reference to the doctrine of the comity of nations. But a judgment *in personam* has no binding force except as to the parties to the action in which it is rendered, and those who claim under them, who are technically said to be in privity with them. The doctrine of estoppel by record does not prevent one injured by a judgment from taking direct proceedings to attack it, and judgments are often set aside on application to the court in which they are rendered. In certain cases courts of equity interfere by injunction to stay proceedings on judgments obtained in courts of law.

Estoppel by Deed.—A party to an instrument under seal is bound by the statements contained in it to those who have acted upon such statements, or, as Lord Mansfield puts it, no man is allowed to dispute his own solemn deed. The estoppel applies to recitals as well as to direct averments. To create an estoppel the recital must be clear and of a material fact, and consistent with the general scope of the deed. As a general rule, estoppels of this class are reciprocal. Thus in the case of a lease, while the tenant can not dispute the title of the landlord, the latter can not deny the right of the tenant. There is also an estoppel by deed of a more technical nature. This grows out of a covenant of warranty. Thus should a person having no title to land convey with covenant of warranty, and afterward acquire the title, he would be estopped by his covenant from asserting his claim to the land. The object of this rule is to avoid "circuity of action."

Estoppel in Pais.—In the time of Lord Coke this division of the principle was applied only to certain acts relative to the title of real estate which the law regarded as possessing equal solemnity and notoriety with a deed. Since then the principle has been greatly extended, and now presents a twofold aspect. In the first place, it is rigorously applied, from motives of general policy, to certain classes of cases. A bailee in general can not dispute the title of his bailor, neither is the indorser or acceptor of negotiable paper allowed to deny the genuineness of any of the preceding names to the paper. In the second place, it is applied when good conscience requires that one should not be allowed to insist on his strict legal rights. The rule which governs its application here may be thus stated: Where one has made a representation or an admission by his words, his action, or, in cases where it is his duty to speak, by his silence, with the intent or expectation, or reasonable grounds for expectation, that others should rely and act thereon, he shall not be permitted to prove that the representation or admission was untrue, if thereby injury would result to one who has in good faith acted upon it. It was at one time supposed that *fraud* was an essential element to constitute an estoppel *in pais*. The better opinion is that no fraudulent design is necessary. It is enough if the party claiming the benefit of the estoppel has acted upon the representations as before stated. The principle, thus limited and applied, is free from the technicalities and harshness which for a long time caused the doctrine of estoppel to be regarded with suspicion by the courts: it is constantly invoked for the prevention of fraud and injustice, and has become one of the most effective agencies of the law. A few instances of its practical application may be cited: A principal may by his conduct be estopped to deny that a certain person is his agent; one who has permitted himself to be held out as a member of a mercantile firm may be estopped as to creditors from denying his membership; a man who has held out a woman as his wife may be estopped from proving that she is not as to tradesmen who have in good faith supplied her with the necessaries of life on his credit; a statement in a bill of lading that the goods were received in good order can not be contradicted as against a person who has made advances relying on the truth of that statement; a bank may be estopped by the act of its cashier in certifying a check. The principle has been extended to the law of real estate. An owner of land who has induced another to incur heavy expenditure on the representation that the latter was owner would be estopped from asserting his own title.

T. W. DWIGHT.

Esto′vers [from O. Fr. *estover*, *estovoir*, subst. of vb. *estovoir*, to be necessary. Various attempts have been made to find a Lat. original, none of them entirely satisfactory]: necessaries or supplies allowed to a person out of an estate; especially the wood which a tenant is allowed to take from the demised premises for fuel, fences, and general agricultural purposes. This right may be claimed by any tenant, whether for life, for years, or at will, unless forbidden in his lease. But only a reasonable amount of wood can be taken; the tenant must not commit waste by destroying the timber, or doing permanent injury to the inheritance. See WASTE. Revised by F. STURGES ALLEN.

Estrades, GODEFROI, Comte d': marshal and diplomatist; b. at Agen, France, in 1607. He negotiated the cession of Dunkirk to France in 1662, and rendered important military services in Holland between 1672 and 1675. He represented France at the congress of Nymwegen, 1678. D. Feb. 26, 1686.

Estray' [from O. Fr. *estraier*, to stray, deriv. of *estrée*, road, street: Ital. *strada* < Lat. *strata* (sc. *via*), paved way]: in law, a domestic animal (the owner of which is unknown) found wandering outside the pasture or other inclosure where it belongs. In England the owner has a year and a day in which to claim such cattle, and the proprietor of the inclosure where they are found must make due proclamation in a church and in the two market-towns next adjoining. When these conditions are fulfilled and the cattle are unclaimed they belong to the sovereign, or now usually, by special grant from the crown, to the proprietor of the inclosure where they are found. The law of estrays varies in different States of the U. S. In general, estrays may be impounded (in a public or a private pound), and after being duly held and advertised may be sold to pay damages and expenses. Revised by F. STURGES ALLEN.

Estremadu'ra: province of Portugal; bounded N. by Beira, E. and S. by Alemtejo, and W. by the Atlantic, and intersected by the river Tagus. Area, 6,876 sq. miles. The surface is mostly hilly; the soil is partly fertile and partly sterile. It is subject to frequent earthquakes. Among the minerals are granite, marble, and coal. The staple productions are wine, oil, cork, fruits, and grain. Pop. about 925,000. Capital, Lisbon.

Estremadura: a former province of Spain; bounded N. by Leon, E. by New Castile, S. by Andalusia, and W. by Portugal; intersected by the rivers Tagus and Guadiana. Between these rivers a long chain of mountains extends nearly E. and W. The northern and southern parts are also mountainous. The soil is fertile, but not cultivated to much extent. Large flocks of sheep are pastured on it. This province contains mines of copper, lead, silver, and coal, which are neglected. It is comprised in the present provinces of Badajoz and Cáceres. Pop. about 750,000.

Estremoz, es-trā-mōz': town of Portugal; province of Alemtejo; about 23 miles N. E. of Evora and 82 miles E. of Lisbon (see map of Spain, ref. 17–B). It has a strong castle on a hill, around the base of which the town is built. Estremoz is noted for manufactures of porous jars which have the property of keeping water cool. Pop. 7,600.

Es'tuary [from Lat. *aestua'rium*, tidal water; deriv. of *aestus*, flood, streaming water, ebb and flow of tide]: the widening mouth of a river of moderate depth where the tides run in from the sea. An estuary is generally formed by the moderate submergence of the lower part of a valley, after which it may be widened by wave and tidal action on its shores and shoaled by deposition of land waste brought in by rivers and tidal currents. Estuaries are therefore frequently of difficult navigation from their shifting bars of sand and mud. The tides of estuaries exhibit a rapid rise and a slow fall, thus making the period of flood and ebb unequal. The rise of flood tide is sometimes so rapid as to form a wall of water advancing up stream. This is known as a bore in the estuary of the Severn, England, as a *mascaret* in the lower Seine, as a *pororóca* at the mouth of the Amazon. Typical estuaries are seen in the lower course of the Delaware and Potomac in the U. S., the Thames and the Firths of Forth and Clyde in Great Britain, and the Elbe and Gironde in continental Europe. W. M. DAVIS.

Étah: a district (and town) of Agra, Northwest Provinces, British India; on the right bank of the Ganges, between the parallels 27° 30' and 28° 1'. Area, 1,739 sq. miles. It is an elevated alluvial plateau, with dry uplands in the W. and occasional saline efflorescence in the cultivated plains nearer the Ganges. Extensive canals are used to irrigate the western portion. The principal products are wheat, cotton, sugar-cane, indigo, and opium. The climate is dry and healthful, but sand and dust storms are common. Étah town is on the Grand Trunk Railway, in lat. 27° 34' N., lon. 78° 42' E. (see map of N. India, ref. 5–E). It has about 10,000 inhabitants. Pop. of district nearly 800,000, nine-tenths Hindus. M. W. HARRINGTON.

Étampes, ā'taàñp', formerly **Estampes** (anc. *Stam'pæ*): town of France; department of Seine-et-Oise; on the Paris and Orleans Railway; 31 miles by rail S. S. W. of Paris (see map of France, ref. 3–F). It has three churches, a castle, and many flouring-mills; also manufactures of hosiery, linen thread, counterpanes, and soap. Pop. (1896) 8,637.

Etawah, e-taa'wăă: a district (and city) of Agra, Northwest Provinces, British India; on the left bank of the Jumna; between the parallels 26° 20' and 27° N. Area, 1,694 sq. miles. It is on the great alluvial plain between the Ganges and Jumna, and in general requires irrigation. About one-half of the district is cultivated. The East Indian Railway runs through the district. Etawah city is on the Jumna, 70 miles S. E. of Agra. The town (see map of N. India, ref. 6–E) is intersected by ravines, crossed by broad bridges, and has about 35,000 inhabitants. Pop. of district about 750,000, of whom about 95 per cent. are Hindus. M. W. HARRINGTON.

Etchemins: See ALGONQUIAN INDIANS.

Etching: See ENGRAVING.

Ete'ocles (in Gr. Ἐτεοκλῆς): a mythical king of Thebes (in Bœotia) and a son of Œdipus. He and his brother Polynices agreed to reign alternately over Thebes, but Eteocles usurped the throne when his brother's turn to reign came. The famous expedition of the Seven against Thebes was undertaken to restore Polynices, who killed Eteocles in single combat.

Ete'sian Winds [*etesian* is from Gr. ἐτησίαι, ἐτησίαι ἄνεμοι, periodic winds; ἔτος, year]; northerly and northeasterly winds which prevail in summer throughout a great part of Europe and in Northern Africa. The name occurs in its Greek form in several ancient writers, and is now occasionally seen in meteorological works. These winds arise in a great degree from the heat of the African Sahara.

Étex, ā'teks', ANTOINE: sculptor, painter, engraver, architect, and author; b. in Paris, Mar. 20, 1806; educated there and in Rome, and achieved distinction in all the departments to which he gave attention. He published an *Essai sur le Beau* (1851); *Cours élémentaire de Dessin* (1859); and *J. Pradier, Ary Scheffer: Études* (1859). D. July 17, 1888.

Eth'elbert: King of Kent; ascended the throne in 560 A. D. He became the most powerful prince (bretwalda) of the heptarchy about 590. His wife, Bertha, a daughter of the King of Paris, was a Christian, and induced Ethelbert and his subjects to profess Christianity in 597 A. D. St. Augustine was instrumental in their conversion. Ethelbert gave to the Anglo-Saxons their first written code of laws. D. Feb. 23, 616 A. D.

Eth'elred (or **Æthelred**) **I.**: Anglo-Saxon King of England; succeeded his brother Ethelbert in 866 A. D. In the first year of his reign the island was invaded by Danes, who conquered a large part of his kingdom. His brother Alfred defeated the Danes in 870. Ethelred was killed in battle with the Danes in 871 A. D., and was succeeded by Alfred the Great.

Ethelred II., surnamed THE UNREADY: Anglo-Saxon King of England; a son of Edgar; b. in 968 A. D. His mother was Elfrida, notorious for her crimes. He succeeded his half-brother, Edward the Martyr, in 978. In his disastrous and inglorious reign the kingdom was invaded and ravaged by the Danes, to whom he paid large sums of money to purchase peace, but they soon renewed their piratical incursions. The Danish king Sweyn took London in 1014, and Ethelred fled to the court of the Duke of Normandy, who was his wife's brother. He died in 1016, leaving two sons—Edmund Ironside and Edward the Confessor.

Eth'elwolf: Anglo-Saxon King of England; the eldest son of Egbert, whom he succeeded in 836 A. D. His kingdom was harassed by several incursions of the Danes, who pillaged London in 851. He defeated these invaders at Okely in that year. He married in 856 Judith, a daughter of Charles the Bald, King of France. D. in 858 A. D. He left four sons—Ethelbald, Ethelbert, Ethelred, and Alfred the Great.

E'ther [Lat. *aether* = Gr. αἰθήρ, clear sky, upper regions of air; cf. αἴθρη, fair weather; αἴθειν, burn, glow]: a hypothetical medium which is assumed to pervade all space, and is regarded as possessing extreme tenuity and elasticity, and as being the medium of the transmission of light and heat, these forces being transmitted by vibrations or undulations of this ether.

Ether: a general name applied to two classes of compounds which are sometimes called *simple ethers* and *compound ethers*, though now, more commonly, *ethers* and *ethereal salts*. They are usually volatile fragrant substances. *Ordinary ether*, often called *sulphuric ether* because sulphuric acid is used in its preparation, is the best-known ether. It is formed from ordinary alcohol by the action of sulphuric acid, and it has been shown to be the oxide of the radical ethyl, C_2H_5, as alcohol is the hydroxide of the same radical. The relation between them is the same as that between potassium hydroxide and potassium oxide, as indicated by the formulæ—

KOH Potassium hydroxide.	K_2O Potassium oxide.
$C_2H_5.OH$ Ethyl hydroxide. (Alcohol.)	$(C_2H_5)_2O$ Ethyl oxide. (Ether.)

Other ethers bear the same relation to corresponding alcohols. Common ether, or ethyl ether, is a colorless, transparent, and highly mobile liquid of characteristic odor and taste. Its specific gravity is 0·736, and it boils at 95°. When its vapor is mixed with air the mixture is extremely explosive. It is a good solvent for resins, fats, alkaloids, and many other classes of carbon compounds. Ether is much used in medicine and surgery as a diffusible stimulant, and is one of the most widely used and safest of anæsthetics. It was introduced by Dr. Morton, of Boston, Mass., and was probably the first complete anæsthetic ever employed. See ANÆSTHETICS.

Ethereal salts, or compound ethers, are analogous to metallic salts (see SALTS), and are formed by the action of an acid on an alcohol, the two reacting in the same way that an acid acts upon an ordinary base. Thus acetic acid acts upon potassium hydroxide and upon ordinary alcohol, as represented in the following equations:

1. $C_2H_3O.OH + KOH = C_2H_3O.OK + H_2O$;
2. $C_2H_3O.OH + C_2H_5.OH = C_2H_3O.OC_2H_5 + H_2O$.

The principal product of the first reaction is potassium acetate, a salt; while the principal product of the second reaction is ethyl acetate, an ethereal salt, or compound ether. This product is also called acetic ether. It is an exceedingly fragrant stimulant and anti-spasmodic. Among other well-known compounds belonging to the same class the following may be mentioned:

Butyric ether (ethyl butyrate, $C_2H_5.C_4H_7O_2$), used in preparing artificial pineapple sirup; pelargonic ether (ethyl pelargonate), for making artificial quince flavor; amyl acetate, for making jargonelle pear essence, extensively used in confections, besides an immense number of other ethers and mixtures used in artificial flavoring; iodic ether (ethyl iodide), used in medicine; nitrous ether (ethyl nitrite, $C_2H_5.NO_2$), used in making sweet spirits of niter. FATS (*q. v.*) belong to the same class of compounds.

Revised by IRA REMSEN.

Eth'erege, or **Etheridge**, Sir GEORGE: English dramatist: b. about 1636. He wrote *She Would if She Could* (1668); *The Man of Mode* (1676); and other successful comedies. He was sent as ambassador to Ratisbon in 1685. D., probably in Paris, about 1694.

Etherion: See the Appendix.

Ethics: See MORAL PHILOSOPHY.

Ethio'pia [Lat. *Aethiopia*, Gr. **Αἰθιοπία**, popularly understood to mean land of the burnt-faces, *αἴθειν*, burn + ὤψ, face]: a name given by ancient geographers to the regions situated S. of Egypt and Libya. The name Ethiopians was originally applied by the Greeks to all the peoples who lived in the southern parts of the known world, including the dark-colored natives of India. As the ancient Greeks and Romans had but little intercourse with the Ethiopians, the accounts which they have transmitted to us are very defective and uncertain. They supposed Ethiopia to be inhabited by several races called Troglodytes, Pygmies, Macrobii, and Blemmyes. According to some traditions, the Egyptians derived their civilization or came themselves from Ethiopia. The connection between Egypt and Ethiopia was at all periods intimate, but the belief has become more prevalent that civilization ascended the Nile instead of descending it. In its extended sense, Ethiopia corresponded to the modern Nubia, Sennaar, Kordofan, and Northern Abyssinia. The population of this vaguely defined region was a mixture of Arabian and Libyan races with the genuine Ethiopians. The latter had well-formed limbs, and a facial outline resembling the Caucasian in all but its inclination to prominent lips and a somewhat sloping forehead. Their language was Semitic. The Nubians and Shangallas of the present time are probably their descendants.

The term Ethiopia proper was restricted to the kingdom of Meroë. The high civilization of Ethiopia, as attested by historians and confirmed by monuments, was confined to the island of Meroë and *Aethiopia Aegypti*. The capital of this region was Napata, on the Nile. It became one of the most powerful and civilized nations of the world as early as 1000 B. C. The government was a sacerdotal monarchy, the priests being the ruling class, as in Egypt. The military power of the Ethiopians was celebrated by Isaiah (xx. 5) and other Hebrew prophets, and the sacred history records their invasion of Palestine. In the eighth century B. C. an Ethiopian dynasty (the twenty-fifth of Egypt) reigned in Lower Egypt. The first king of this dynasty was Sabaco, whose son and successor, Sebichus (the So or Seva of the Bible), was an ally of Hoshea, King of Israel, in 722 B. C. It is stated that in the reign of the Egyptian King Psammetichus (630 B. C.) the military caste, numbering 240,000, migrated into Ethiopia. It was invaded by the army of Cambyses, King of Persia, in 530 B. C. According to Josephus, he conquered Meroë. In the reign of Augustus Cæsar, Candace, Queen of Ethiopia, waged war against the Romans. Having been defeated, she sued for peace, and became tributary to him in 22 B. C., but the Roman tenure of Ethiopia was always precarious. Early in the fourth century many Christian churches were planted in Ethiopia. See Hopkins, *Travels in Ethiopia* (1835). See ABYSSINIA.

Revised by C. K. ADAMS.

Ethiopic Language: the language of the Geez or Ag'âzi (i. e. those who have traveled, or the free). Modern philologists use Geez as the more accurate, in preference to Ethiopic language, the more general term, for it has nothing in common with the language of the race called by the ancients Æthiopes (the Cushites of the Bible); and in the large empire of Abyssinia, which was called Ethiopia in the Middle Ages, there were and are still many other languages. The Geez were one of the Semitic tribes, who had emigrated from Arabia to Abyssinia, and had settled in Tigre and its capital, Aksum. In the large Abyssinian empire which grew up around Aksum, and which was gradually Christianized after the fourth century, this Geez language became the official and the Church language, beside which the dialects and languages of the different native tribes still continued to exist, but were not used as written languages. In this ruling position as the official language of the empire it continued to maintain itself until the middle of the thirteenth century, when, in consequence of a change of dynasty, the Amharic language gradually gained the ascendency at the imperial court, and entirely superseded the Geez as the official language. But its position as the language of the Church and of the scholars of Christian Abyssinia it did not lose in consequence of this political revolution. The clergy and literary men were for centuries compelled to have a knowledge of it, and understood it even well enough to write books; and the old Geez books continued to be copied. During the last 300 years books of all kinds have been prepared in the AMHARIC LANGUAGE (*q. v.*), which is more familiar to the people, and even the Bible or parts of it have been translated, especially at the instance of the Protestant missionaries, into the modern languages of Abyssinia, in particular into the Amharic and Tigre, without diminishing, however, the influence of the old Geez translations. As a popular language the Geez has died out even in Tigre, its original home, or rather it has been modified in the mouths of the people into dialects. Among these descendants of the Geez language two principal dialects are distinguished: the Tigre, which is closely allied to the Geez, and which is spoken by nomadic tribes in the extreme north, in the regions bordering on Nubia and Sennaar, which for a long time have been cut loose from Abyssinia; and the Tigriña, which is spoken in the old province of Tigre and the neighboring districts, and which has degenerated more than the other in sounds, forms, and fullness of words, and is largely mixed with Amharic words. A grammar of this language has been published by Prætorius, *Grammatik der Tigriñasprache* (1872).

The Geez is a purely Semitic language, but still, in its way, is very peculiar, and is justly regarded as a special branch of the Semitic family. Its relation to the language of the Himyaritic monuments (i. e. the Sabean) can hardly be said to be nearer than its relation to the Arabic as now written. It has, however, much in common with the entire Arabic group of languages, not only in regard to the stock of words, but also in regard to the system of sounds and the formation of words; and although it has never attained the fullness of forms of the Arabic, it has developed some Semitic peculiarities, even more consistently than the written Arabic. But in many words, roots, forms, and even in many syntactic forms, it agrees more with the northern Semitic languages, especially with the Hebrew, but also with the Aramaic and the Assyrian. It must therefore be assumed that the Geez, after its branching off from the northern Semitic, continued to develop itself in connection with the southern Semitic (Arabic) languages, but separated itself very early from these, and continued to go along its own path. For this reason it has still many peculiarities of the ancient Semitic languages—peculiarities which have been abandoned even in the Arabic; and in some respects has retained the most ancient forms (e. g. it has no article). Other forms it has developed in a peculiar manner, contrary to the method of all other Semitic languages (e. g. most of the prepositions and conjunctions). Especially in the method of construction it has formations which are hardly to be found in the other Semitic languages, and has acquired a flexibility of syntax which distinguishes it favorably from all the other languages related to it. On the other hand, besides many ancient and peculiar forms in the Geez, there are met, strange to say, many forms which the other Semitic languages only reached in their latest stages of development (e. g. the disappearance of the inner passive and of the participial form, the dropping of short vowels, etc.); and it may be inferred from this that the Geez, as it is presented in the Abyssinian books, has already passed through a long stage of development. From this it is seen that the study of the Geez is very important and instructive to the Semitic philologist.

The Geez has never been grammatically treated by native (Abyssinian) scholars. In Europe, after several very incomplete attempts in the sixteenth and seventeenth centuries, it was treated of in a grammatical and lexicographical exposition, which for its time was excellent, by Hiob Ludolf (*Grammar and Lexicon*, 1661; 2d ed., *Lexicon*, 1699, *Grammar*, 1702). In accordance with the demand of modern linguistics, and on the basis of a much fuller knowledge of Ethiopic literature, the language has also been treated of by A. Dillmann (*Grammar*, 1857; *Lexikon*, 1865), and in shorter form by F. Prætorius (grammar, with chrestomathy and glossary, 1886, one of the volumes of the *Porta Linguarum Orientalium*). See also E. Schrader (comparison between Ethiopic and the cognate languages, 1860); B. Stade (on the quadriliterals, 1871); and E. König (on script, pronunciation, and forms, 1877).

The Geez is written with peculiar characters, which originally were identical with the Himyaritic and old Arabic characters found in the inscriptions of Syria and Assyria, and were afterward only slightly modified. It is written from left to right, and is also remarkable in that it separates the single words by two dots (:), and that the writing of vowels by means of little lines and hooks, which are attached to the consonants, is uniformly carried out. These characters were subsequently used in Abyssinia for the other dialects and languages also, especially for the Amharic and the Tigriña, but enriched by several new characters, so that they can be said to have become the universal alphabet of Abyssinia. AUGUST DILLMANN. Revised by C. H. TOY.

Ethiopic Literature: the literary monuments in the ETHIOPIC LANGUAGE (*q. v.*). The oldest monuments of the Ethiopic characters and language which are known at present do not date beyond the first centuries of the Christian era. They are coins and inscriptions; among the latter especially the large inscriptions of Axoom, which have been made known to the world by Rüppel in the account of his travels. They mostly show an archaic mode of writing the consonants, and the vowel-signs are only in their infancy. An Ethiopic literature came into existence after the introduction of Christianity into Abyssinia (in the fourth century), and has always retained a predominantly religious character. Its basis was the translation of the Bible, both the Old and New Testaments, together with the semi-biblical, apocryphal, and pseudepigraphic books belonging thereto, which in the other churches were rejected or lost (as the book of Jubilees, of Enoch, the Apocalypse of Ezra, the Ascension of Isaiah, the Shepherd of Hermas, and others). The entire translation was made from the Greek, but was afterward revised several times—the Old Testament at last even from the Hebrew; and it is necessary therefore to distinguish between the old, middle, and latest revisions of the text. The pseudepigraphic books are nearly all printed. A critical edition of the Old Testament has been begun by Prof. Dillmann, and has progressed (1893) through the second book of Kings. The Psalms and Solomon's Song have been published several times. The New Testament was printed at Rome in 1548, and was reproduced in the London Polyglot with many mistakes. The edition (now out of print) of the English Bible Society (by P. Platt, 1826) gives a mixed text, which can not be used for critical purposes. The other literature consists, for a large part, of translations of Greek and even Coptic works, and after Mohammedanism had taken root in Egypt, the mother country of the Abyssinian Church, Arabic works also were translated. The literature comprises theological and religious works of every kind, such as collections of old canons (Clementina, Didascalia, Synodus), catenæ, and homilies, exegetical and dogmatical writings (especially those of Cyril, Epiphanius, Chrysostom, and also of the Syrian Fathers, especially those of the Monophysitic Church; Haimânôta Aban (i. e. a large collection of confessions of faith of the monophysitic teachers); lectionaries for the whole year, especially for the fasts and the Passion-time; horologia, liturgies of the mass, and church-books for the other sacraments, and for burials, church discipline (Faus Manfasawi), and church law (Fetha Nagast), Acta Sanctorum (Synaxa), a large number of monastic rules and monastic writings; in sacred and profane history and chronology the works of Joseph Ben Gorion, George Ben Amid, Abushaker, and others, and even something relating to philosophy and the natural sciences.

Among the native productions of the Abyssinians themselves are dogmatic treatises, pseudonymous apocalyptical writings, numerous prayer-books and formulas, meditations, eulogies and biographies of saints, martyrs, monks, and archangels in prose and verse, mostly productions of monkish imagination and an insane belief in miracles. More important in their way are the large ancient hymn-books (Degwâ, Mawâs'et, Me'râf), with hymns and antiphonies, not only for Sundays and holidays, but for every day in the year, and containing formulas for the ceremonies in honor of all the saints of the calendar, with peculiar notes for singing, the use of which has been very imperfectly explained. Most of these works, which indicate a considerable progress in religious poetry and music, have been traced back to a certain Jared in the sixth century. Besides these there were also large works on native history, and explicit annals of the several kings (from which J. Bruce in the second volume of his travels has given extracts), which were written in a peculiar language, a mixture of the Geez and the Amharic. After the extinction of the Geez a beginning of grammatical and lexicographical work was made, and was deposited in many Ethiopic-Amharic glossaries (Savasev).

Much was also written during this period on medicine, witchcraft, exorcism, and divination for the superstitious people, either in Ethiopic-Amharic or entirely in the Amharic language. The poetry was almost entirely in the service of the Church and of religion. At all events, poems on secular affairs in the Geez language have not been preserved. Besides the peculiarly arranged hymns, only lyrical poetry was developed. The poems are divided into strophes of equal length. The construction of the strophes shows many varieties: the lines are rhymed; the syllables are neither measured nor counted. Of real poetic genius there are but few traces in these poems; many have of poetry nothing but the rhyme.

Of the entire literature there have been printed besides the Bible the *Hermas Paster* (1860); Æthiopic liturgies and prayers (1865); *Physiologus* (1877); and a number of things in the journals of the French and German Oriental societies. It is very fully represented in manuscripts in all the large libraries of Europe, especially in Rome, Paris, Oxford, London, Tübingen, Frankfort-on-the-Main, Vienna, and Berlin. Since the Abyssinian war in 1868 the collection of the British Museum has been so largely increased that it is without doubt the largest in Europe. All the older and most of the later manuscripts are written on beautiful parchment. Among the manuscripts none date further back than the fifteenth century. Catalogues have been published of the collections in St. Petersburg (1837); Würtemberg (1843); Tübingen (1847); Oxford (1858); Paris (1859); Vienna (1862); and London (1870).

AUGUST DILLMANN.
Revised by C. H. TOY.

E'thiops Mineral: the black powder obtained by triturating mercury with sulphur. It is a sulphide of mercury. The term ethiops was formerly applied to other black powders.

Ethmoid Bone [*ethmoid* is from Gr. ἠθμός, sieve + εἶδος, form]: a bone in man placed between the orbits and at the base of the nose, and receiving its name from its numerous perforations, through which pass the branches of the olfactory nerve. In comparative anatomy the term ethmoid is applied in combinations to various structures, but it belongs properly to an impaired cartilage bone developed at the union of the trabeculæ in front of the pituitary space. In man it consists of four parts—the cribriform plate, the perpendicular plate, and the two lateral masses. In the condition called "pug nose" the perpendicular plate is deficient, and in consequence the bridge of the nose is low.

J. S. KINGSLEY.

Ethnology [from Gr. ἔθνος, nation + λόγος, discourse]: in common usage, the science which treats of the division of mankind into races, their origin, distribution, and various characteristics, including the whole science of man. In a more restricted sense, it is the science by which men are classified into races or groups distinguished by physical characteristics, as the color of the skin, the structure of the hair, the attitude of the eyes, the form of the skull, the proportions of the skeleton, etc.; but this use has not largely prevailed. The tendency at the present time is to apply the word to that science which treats of the culture of the tribes and nations of mankind, or the origin, development, and condition of industrial and decorative arts and the arts of amusement; the arts of society; the arts of language; the arts of literature; the fine arts; natural religions; and, finally, the opinions of mankind. These subjects give rise to a series of sciences which will now be mentioned in the order above indicated.

Technology.—This term is sometimes used to denote the science of industrial arts. Perhaps it is well to extend its signification so as to include also the science of the arts of decoration and of the arts of amusement. Modern investigation has demonstrated that all industrial arts have had a lowly beginning among savage tribes, who first learned to re-enforce the labor of their hands with rude tools and implements made of stone, bone, horn, shell, wood, sinew, skin, animal and vegetable fiber, and various other substances. The rude tools and implements of this earliest stage of culture are found everywhere throughout the habitable globe, as vestiges and evidences of the lowly condition of primeval man. It is customary to speak of man while in this condition of culture as existing in the "stone age"; but this stone age was not a synchronous period throughout the habitable earth. It seems to have begun earlier in some regions than in others, and it certainly extended much later in some lands than in others. The term stone age is commonly used as one of a series, namely, stone age, bronze age, and iron age. These particular ages, or, more properly, stages of culture, are not well established over all parts of the earth, but are rather applied to stages of culture in Europe and in some smaller portions of Asia and Africa. Another method of seriating the stages of culture is of wider application and of greater significance, viz.: first, the hunter stage; second, the shepherd stage; third, the artisan stage; fourth, the inventor stage. In the first stage man derived his food from nature, by hunting, fishing, and harvesting the fruits and roots of the forest and plain. In the second stage man cultivated the soil to some extent, and domesticated animals, and from them derived his food and clothing, all men generally being engaged in the same occupation. In the third stage, marked especially by the growth of "city states," men were engaged in various trades and occupations, using tools made of the metals and various other materials. Thus arose a division of labor, one man producing articles for the use of others, and obtaining from them in exchange the many things needed by himself. In the fourth stage, which is the modern period of highest culture, such trades and handicrafts are to a greater or less extent superseded; the powers of nature are employed to drive machinery, which men operate in such a manner as to multiply products with great economy of human strength.

The *arts of decoration and amusement* have not been satisfactorily seriated, or classified in stages.

Sociology is the science of institutions or the arts of society. These arts or institutions are usually grouped in three great classes, viz.: economics, or political economy; civics, or the science of government; and ethics, or the science of morality.

Four stages of economic culture may be quite clearly discerned, but, like all such stages, well-defined planes of demarkation are not found, as lower stages develop gradually into higher. Among the lowest tribes a stage of communal property is found, when much the larger part of all the property is owned by the clan, the gens, or the tribe. In this stage only a few articles become the property of individuals, and such property is usually destroyed on the death of the owner. The second is the barter stage, when property is exchanged for property to supply the wants and desires of the exchanging parties. In the third stage a measure of value and medium of exchange is provided by the invention of money; and this stage is approximately coeval with the artisan stage of industries. The fourth stage is the credit stage, when business is transacted through banks and clearing-houses by an exchange of credits.

The civic or governmental stages of culture are most fundamentally characterized as two. The first and lowest is the tribal stage, where the organization of the body politic is a *societas* organized on the basis of actual or theoretical kinship. The second and higher stage is national, where the body politic is organized on a territorial basis, giving the *civitas*.

Savagery and Barbarism.—Tribal society may be divided into two stages. The first and lowest may be called the clan stage, or savagery, in which kinship is primarily reckoned through the female line in such a manner that the children belong to the clan of the mother. Clans thus reckoned by kinship in the female line are grouped into tribes by kinship in the male line and by intermarriage; so that kinship through females, kinship through males, and kinship by marriage are alike recognized. Barbarism is gentile society, in which kinship in the gens—which corresponds to the clan in savagery—is reckoned in the male line. A number of such groups, or gentes, are organized into a tribe. In the gens only kinship through males is recognized; in the tribe, kinship through females and kinship by intermarriage are recognized.

Patriarchies are forms of government peculiar to barbarism, or the gentile structure of tribes. In them the elder man becomes chief of the gens, and in some cases holds despotic sway over a large group of descendants composed of his own family and the families of his younger brothers. The property of the clan is communal, but is to a greater or less degree under the control of the patriarch.

Exogamy and Endogamy.—An attempt has been made by some writers to show that two systems of marriage have widely prevailed in the world, one called exogamy and the other endogamy, but it is now known that, in the case of American tribes at least, these are only two aspects of the same form of marriage. In tribal society the people are exogamous in relation to one group—that is, they must marry outside the clan or gens; but they are endogamous in relation to another and higher group, for they must marry within the tribe.

Feudalism is a transitional stage between tribal society and national society. By the institution of feudalism tribes are fused under the authority of great leaders, who are often landholders on an extensive scale. Their retainers render them service, especially in war, and are under the protection of their lords, who stand between them and the crown.

Perhaps national society may be best seriated in two stages, imperial sovereignty and popular sovereignty. In the first the state is theoretically, and sometimes actually and wholly, under the authority of the ruler, and property is held in trust or by the grace of the ruler. In the second stage the citizen is the sovereign, from whom the ruler derives his authority through constitutional law, and the authority of the ruler over the property of the subject theoretically extends only so far as may be necessary to collect taxes for public purposes.

The subject of ethics not only involves a consideration of the development of human culture, but is also related on the one hand to philosophy and on the other to religion.

Philology or *linguistics* is the science of languages. Attempts have often been made to classify languages by grammatical structure, but no such system of classification has received universal or even general acceptance. An attempt has been made to classify languages genetically by throwing together those having a common origin. To a large extent this classification is based upon vocabularies, and to a slight degree upon grammatic characteristics. This classification is yet incomplete. Many families or stocks of languages are now recognized, but there are numbers of languages outside of the recognized stocks that have not yet been studied to such an extent as to reveal their proper affinities and indicate the groups to which they belong. The work of classifying languages is one of vast extent, requiring long and painstaking research, and it must be many years before the task is completed.

Formerly it was expected that linguistic research would reduce the families of languages to a very small number, and by some it was even supposed that all would be traced to a common primeval speech; but these expectations have not been realized, though many languages so diverse as not to be mutually understood by the speakers have been traced to common origins. On the other hand, research has brought to light a greater number of distinct families or stocks of languages. With the progress of culture languages of the same stock have differentiated, while the lower tribes of mankind appear to have a great number of languages belonging to totally distinct stocks; so that, while there has been some differentiation of languages within the same family, the general progress has been toward their unification. As culture progresses fewer tongues are spoken, and a single tongue is common to an ever-increasing body of people. Often distinct languages of the same stock are formed by amalgamating with languages of other stocks, so that independent tongues disappear and are found only as integral elements in stocks that are preserved. All evidence goes to show that in savage society a vast number of wholly independent languages are developed, and that these languages coalesce to some extent and many become extinct.

Literature.—The lower tribes of mankind who have not developed written languages are always possessed of a great body of myths, folk-lore, and legends, which are handed down orally from generation to generation. In it the superstitions of the people are almost inextricably confounded with their history. Whenever such a people in the progress of its culture becomes possessed of the art of writing, more or less of this oral literature is permanently recorded, especially in songs and tales; such is everywhere the root of literature. With the more advanced peoples poetry, romance, and drama are abundantly developed, until gradually a literature of science springs up.

The æsthetic or fine arts also belong to the subject of ethnology. For this science the term *æsthetology* has been proposed. It treats of the origin, development, and characteristics of the fine arts. Authors are not wholly agreed as to what are the fine arts. Some would include poetry, romance, and drama in the fine arts; others classify these arts as literary. All agree that sculpture, painting, and music belong to the fine arts, and by most authors architecture is considered one of the fine arts, though perhaps with less substantial reasons. When the term architecture was applied to the construction of temples and great public works, and especially when these works were highly symbolic, the inclusion of architecture in the fine arts could be supported with cogent reasons, but in modern times the term architecture is applied to the construction of all classes of buildings. To an overwhelming extent the art is applied to industrial structures. For this reason architecture may be included among the industrial arts, its chief motive being the production of the economically useful.

Sculpture has a very lowly beginning with primeval man, for the lowest tribes of which there is knowledge carved images of men and animals in stone, bone, wood, and other materials, chiefly to develop the paraphernalia of religious worship. This art attained a very high degree of development in early civilization, especially among the Greeks, whose works are renowned for beauty and artistic expression.

Painting also begins in the lowest known stage of culture, when rude pictures are formed of human beings, the lower animals, and various inanimate objects. The purpose of these crude pictures seems to be in the main mnemonic, and they are known as picture-writings. Such graphic art is rude and conventional, but it steadily develops through savagery, barbarism, and civilization along two distinct lines. On one hand the picture-writings become more and more conventional, until ideographic writing is produced, then syllabarics, and finally alphabets. On the other hand, picture-writing develops into modern painting, and becomes properly an æsthetic or fine art. The stages of this development may in a general way be characterized as the flat stage, the relief stage, the perspective stage, and the chiaroscuro stage. In the first the picture-writings are mainly flat representations of objects, without relief or perspective, and are often found as monochromes. The picture-writings of the North American Indians are chiefly of this character. In the second stage skill in the representation of relief is developed. Most of the known graphic art of Egypt is of this character. In the third stage the power to represent objects as related in perspective is developed. The struggle of art through the stages of perspective drawing is well illustrated in Chinese and Japanese art, where imperfect perspective and conventional forms are often found. The fourth stage is represented by modern graphic art, where to relief and perspective is added aërial perspective, with a nice gradation of lights and shades and a high appreciation of the values of the constituent parts in developing the central thought of a work of art.

Music is born of the dance, and the earliest is purely rhythmic, its purpose being to mark time for terpsichorean performances. The music of the American Indians is largely of this character, though a slight development of melody is discovered. The second stage is the melodic, in which themes are repeated with variations. The third stage is the harmonic, which is a union of coexistent melodies. The fourth stage is the symphonic, when music is a succession of harmonies with varying themes. Often the æsthetic arts are combined in song, music, and poetry; while in the opera, music, poetry, drama or histrionic art, and even painting, are combined.

Religions, as naturally developed, are usually included in the subject of ethnology, while the subject of revealed religion, or theology, is excluded therefrom. The subject of natural religion is presented under two heads: mythologies, as theories of supernatural beings and their relation to mankind and the universe; and worship—to which the term religion is sometimes exclusively applied—which deals with the methods of propitiating and otherwise influencing such beings. It will thus be seen that the whole subject of mythology is logically included in the science of opinions, and the term religion should then be applied only to worship, but the more common usage makes it include mythology and worship. Religions are many. In tribal society every tribe has its own religion, consisting of a pantheon of superhuman beings and a system of worship. Each tribe recognizes the religion of other tribes, and cultivates its own religion for a variety of purposes: to preserve health, to cure disease, to bring abundant harvest, to prevent storms, floods, and droughts, and in general to avert all the evils to which mankind is subject, as well as for the purpose of exalting its own deities and obtaining their assistance in thwarting the deities of hostile tribes. In these natural religions four stages of philosophy or theology are discovered. The first has been characterized by Tylor as *animism*, in which inanimate things are supposed to have supernatural powers, and to be endowed with life and mind; mountains, rivers, trees, stones, and other inanimate things are held to be of equal power with the animate world, the lower animals and man. The second stage may be styled *zoötheism*, in which the distinction between the animate and inanimate is made; spirits of mountains, rivers, and other great geographic features there are still, but these are usually supposed to have animal forms. The pantheon is chiefly made up of beings with animal forms—wonderful mammals, birds, reptiles, and fishes, and mythic articulates, mollusks, and radiates. The people do not worship the live animals, but only mythic animals, to which are attributed many powers, and which are supposed to have a supernatural existence, and to have been the progenitors or prototypes of the existing animals. In this stage, too, the sun, moon, stars, and other heavenly bodies and phenomena are worshiped as gods, and they are supposed to have the forms of the lower animals, though sometimes, but rarely, of men. The third stage may be characterized as *physitheism*, in which the heavenly bodies and the great powers and phenomena of nature are personified and deified. The fourth stage may be denominated *psychotheism*. Gradually the natural gods, as powers, assume especial psychic characteristics and come to preside over realms of life, passion, and human interests: thus there is a god of war, a god of love, a god of revenge, a god of agriculture, etc.

The methods of worship can, in a general way, be characterized in stages, though the series of stages necessarily coalesce as the lower is developed into the higher. Of the worship attending that stage of theology known as animism, little is known. In zoötheism the principal form of worship may be called terpsichorean. The gods are mainly influenced by dancing and music, but to this a variety of crude ceremonies is added. In the third stage terpsichorean worship still remains, but to it is added a vast system of sacrificial worship, where wine, fruits, animals, and men are offered to placate or otherwise influence the mythic gods. In this stage terpsichorean worship is developed into dramaturgy, and ceremonies are highly dramatic and thaumaturgic, or wonder-working. In the fourth stage terpsichorean worship wanes; sacrificial worship with dramatic performances still remains, but to it is added an important element of what may be called fiducial worship, which is characterized by profound belief in the gods, faith in their powers, and reliance on them for all the good of life. This new form of worship is especially characteristic of psychotheism.

Opinions.—It has been proposed to designate the science of opinions by the term *sophiology*. This science derives an important part of its material from the history of the growth of concepts as they are expressed in parts of speech. Another great source of material is discovered in the history of literature, in which the opinions of mankind are recorded. Mythologies, which are very numerous, and of diverse characters, afford a wealth of material upon the same subject. Finally, the history of the sciences contributes its materials. Two great systems of opinions have existed side by side throughout the entire history of human culture, which may be designated as mythological opinions and scientific opinions. In the earlier history of mankind the mythic basis prevailed; in the later, the scientific; so that development has been from myth to science. J. W. POWELL.

Ethyl Butyrate: See BUTYRIC ETHER.

Ethylene, Olefiant Gas, or **Bicarbureted Hydrogen**: a gas (C_2H_4) produced by heating alcohol with strong sulphuric acid or boric anhydride; also by the dry distillation of many organic bodies, as fats, resins, wood, coal, many salts of organic acids, etc. It is an important constituent of coal gas, the illuminating power of which is largely due to its presence. It is colorless, and has a faint ethereal odor, which is attributed to a slight contamination with ether vapor. Its specific gravity is 0·9784. By pressure and cold it may be condensed to a limpid liquid. It burns in the air with a bright white flame, which is very luminous. It is a diatomic radical, uniting with two atoms of Cl, Br, Cy, and other monatomic radicals, and with one atom of O, S, and other diatomic radicals. By replacing hydrogen in two or more molecules of ammonia, it produces diamines, triamines, etc. Its compound with chlorine ($C_2H_4Cl_2$) has long been known as "Dutch liquid."

Étienne: See STEPHANUS.

Etiolation [from Fr. *étioler*, be blighted; cf. O. Fr. *esteule*: Ital. *stoppia* < Lat. *sti'pula*, *stu'pula*, stubble, straw]: the state of a plant which is deprived of green color by the exclusion of light. When it is obtained by keeping plants in the dark in order to render them tender and less acrid, it is called *blanching*, as in the case of celery. In this process the chlorophyll pigment disappears from the chloroplasts in the cells, leaving them colorless.

Revised by CHARLES E. BESSEY.

Et'ive, Loch: a salt-water lake or inlet of the sea in the county of Argyle, Scotland. It is 20 miles long, and varies in width from half a mile to 3 miles. It receives the river Awe, and communicates with the Firth of Lorn. Grand and romantic scenery occurs along its banks.

Etna (in Gr. Αἴτνη; Lat. *Æt'na*; Sicilian, *Mongibel'lo*): a volcanic mountain of Sicily; in the northeast part of the island, adjacent to the sea and very near to the city of Catania. It is an isolated mass of conical form, having no connection with the other Sicilian mountains, from which it is separated by the valley of the river Alcantara. It has an altitude of 10,935 feet above the level of the sea, and its base is about 90 miles in circumference. The volcanic phenomena, which it presents on a greater scale than is elsewhere seen in Europe, early attracted the attention of the ancients, and were described by Pindar, who mentions the rivers of fiery lava rolling down its side into the sea. Thucydides states that an eruption occurred in 425 B. C. It is recorded that four violent eruptions occurred in a period of twenty years—viz., 140, 135, 126, and 121 B. C. The city of Catania has repeatedly been nearly ruined by the eruptions and earthquakes.

The form of the mountain leads to the belief that it was once more lofty than now, the upper part of its cone having

Etna.

probably been blown into the air by a stupendous explosion. The crater thus produced has been filled up by subsequent eruptions, and a new cone built over it. A terrace, or shoulder, high up on the slope separates the new cone from the surviving part of the old. The Val del Bove, a great valley on the east slope, probably marks the scene of another explosion. It is partly filled by later lavas. The eruptions of modern times have usually issued from fissures on the flanks instead of from the summit, and all the slopes, including the Val del Bove, are characterized by numerous cinder cones, marking the positions of subsidiary vents.

The lower part of the mountain, up to an elevation of 2,300 feet, is densely inhabited and very carefully cultivated. The soil, consisting of decomposed lava, is exceedingly fertile, and all the ordinary Sicilian products are raised there with ease and to perfection. At a height of 2,300 feet a forest belt begins, and extends to an elevation of about 6,300 feet. Above 6,300 feet the desert region—vast wastes of black sand, ashes, lava, etc.—begins, and extends to the summit. It is covered with snow for about eight months in the year, and snow may be found in certain rifts near the summit in midsummer. The Casa Inglesi, a house of lava built by the English officers stationed in Sicily in 1811, stands at an elevation of 9,652 feet. Revised by G. K. GILBERT.

E'ton: a town of Buckinghamshire, England; on the Thames, opposite Windsor; 22 miles W. of London (see map of England, ref. 12–J); pop. (1891) 2,499. It is the site of Eton College, one of the most famous educational institutions of England, founded and richly endowed in 1440 by Henry VI., although the buildings were not completed until 1523. It is a favorite school of preliminary instruction for the sons of the nobility and gentry. Many scholars are at the age of seventeen elected to valuable scholarships at King's College, Cambridge. Eton is governed by a provost and seven fellows. The main portion of the establishment, numbering nearly 900, consists of the *oppidans*, who live outside of the college, and for whose tuition the same price is paid as for that of the *collegers* or scholars. The number of the latter is limited to seventy.

Etru'ria, or **Tuscia**: an important country of ancient Italy; called **Tyrrhenia** (Τυρρηνία, or Τυρσηνία) by the Greeks. It was bounded N. by the Apennines, E. by the Tiber, and W. by the Mediterranean or Tyrrhenian Sea. The inhabitants were called Etruscans (*Etrusci*) and Tuscans (*Tusci*) by the classic Latin writers. Their national name in the Etruscan language was *Rasena*. The chief rulers bore the general title of *lucumo*. The cities which composed the league of Etruria proper are universally reckoned as twelve in number, but these can not all be identified, as no ancient writer has preserved a list of their names. Among the most important were Tarquinii, Veii, Clusium, Volsinii, Cortona, Cære, Perusia, Arretium. The early traditions mention several Etruscan kings, as Porsena, King of Clusium, but during the greater part of the historic period the political constitution was an aristocracy.

Origin and History.—The question of the origin and affinities of the Etruscans has long exercised the ingenuity of scholars and antiquaries, but it still remains undecided. The opinion generally adopted by Roman writers ascribed to them a Lydian origin. The earliest authority for this tradition is Herodotus, who states that he received it from the Lydians. This opinion was rejected by Hellanicus, who represents the Etruscans as Pelasgians, and by Dionysius of Halicarnassus, who considered them indigenous (*autochthones*), and states that in his time they were very distinct from every other people in language as well as in manners and customs. Niebuhr maintained that they were a mixture of Pelasgians and Umbrians with a race of northern invaders (*Rasena*), who conquered them at an unknown date. He believed that the Rasena or Etruscan nobility came originally from the Rhætian Alps. Knowledge of the history of the Etruscans, even during the period of their greatest power and prosperity, is very vague and imperfect. The Etruscan language is thought to be Indo-European in its grammatical construction, though its vocabulary, so far as ascertained, can not be with any certainty affiliated. There is no Etruscan literature extant, and no bilingual inscriptions of any length have been found. There were three Etrurian centers of occupation: (1) from the Tiber northward to Pisa, where the Etruscans seem to have been limited by the Ligurians; (2) the settlement on the Po, of which Bologna, Verona, and Mantua were the principal cities; the Etrurian population is shown by inscriptions to have extended northward as far as the Rhætian Alps; (3) that in the Phlegræan plains surrounding Capua and Nola, which are regarded as Etruscan cities. Livy states that before the Romans became the dominant people of Italy the power of the Tuscans was widely extended both by sea and land. Several Greek writers attest the facts that they were bold and enterprising navigators, and fitted out large fleets for naval warfare. In 538 B. C. they fought a naval battle against the Phocæans at Corsica. The Tuscans and Carthaginians were allies on this occasion, and in other battles against the Greek colonies of Italy. Besides the twelve cities of Etruria proper, these people possessed another state or confederacy on the northern side of the Apennines. According to the Roman traditions, the Tuscans were a powerful nation before the foundation of Rome, 753 B. C. It probably attained its greatest power about 150 years later. The Tuscan cities of Clusium and Veii were involved in several wars against the rising power of Rome. Tradition indicates the establishment of an Etruscan dynasty at Rome under the later kings, the two Tarquins, and assigns to this period of Etruscan domination the construction of the Cloaca Maxima and the Capitol. About 508 B. C., Porsena, King of Clusium, marched against Rome, and, as the best critics believe, captured it. Hostilities continued, with occasional intervals, between the Romans and the Veientes from 483 B. C. to 396 B. C., when Veii was captured by Camillus and destroyed. It does not appear that the other Tuscan cities gave any aid to Veii during this period. This apparent neutrality may be explained by the fact that their northern frontier was then infested by predatory hordes of Gauls, whom they were scarcely able to repel. In the subsequent wars it was sometimes Tarquinii and sometimes Volsinii that fought against Rome. About 309 B. C. the combined forces of several Etruscan cities were defeated by Fabius Maximus in a battle which gave the first decisive blow to their power. The conquest was completed by a victory which the Romans gained at the Vadimonian Lake in 283 B. C. The Etruscans, however, retained long after this event their own language, customs, religious rites, and nationality. They were admitted to the Roman franchise in 89 B. C.

Arts and Civilization.—Ancient writers concur in representing the Etruscans as the most cultivated and refined people of ancient Italy, and as especially skillful in ornamental and useful arts, in which the ideas and patterns used singularly resemble those of Egypt. The Romans derived from them many arts and inventions that conduce to the comfort of life. The genius of the Etruscans appears to have been practical rather than speculative. They excelled in agriculture, navigation, engineering, and in useful public works. They had made great progress in architecture, sculpture, and painting, and especially in bronze-work and gold jewelry; but their artistic ability was far inferior to that of the Greeks. The so-called Tuscan order of architecture is a Roman, and more especially a Renaissance modification of the Doric. The Cloaca Maxima at Rome proves that they were acquainted with the true principle of the arch, and exemplifies their skill in the construction of sewers. Of their temples, theaters, and amphitheaters no considerable remains have been preserved. Among the existing monuments of their massive and cyclopæan masonry are fragments of walls which defended the cities of Cortona, Fæsulæ, Clusium, and Volaterræ. Their tombs are in some cases chambers hewed in a cliff or solid rock, and adorned outside with façades like those of temples. The interior walls are decorated with paintings, and the tombs contain vast numbers of vases, tripods, urns, etc. The Etruscans excelled in several branches of plastic art, especially in the fabrication of bronze articles and pottery. Bronze statues and utensils were exported from Etruria in immense numbers. Among the extant specimens of their bronze-work are probably the figure of a she-wolf in the Capitol of Rome, of which group, however, the two children are modern, and the Chimæra in the Museum of Florence. The painted vases called Etruscan, which have been found in great numbers, especially at Chiusi (Clusium) and Vulci, are Greek in design and workmanship. The metallic specula or mirrors, adorned with figures on one side, a peculiarly Etruscan manufacture, are prized as illustrative of customs, mythology, etc.

AUTHORITIES.—K. O. Müller, *Die Etrusker* (2 vols., 1828); Deecke's *Etruskische Forschungen*; Pauli's *Etruskische Studien*; Abeken, *Mittel Italien* (1843); Dennis, *Cities and Cemeteries of Etruria* (1848); Inghirami, *Monumenti Etruschi* (7 vols., 1821–26); Micali, *Storia degli Antichi Popoli Italiani* (3 vols., 1832); the writings of Isaac Taylor and of Crawford on Etruscan Inscriptions; Brunn's *Rilievi delle Urne Etrusche* (Rome, 1870); Jules Martha, *L'Art Étrusque* (1888); and E. S. Bugge, *Etruskisch und Armenisch* (1890). Revised by C. K. ADAMS.

Etruscans: See ETRURIA, and ITALIC LANGUAGES.

Ett'müller, ERNST MORITZ LUDWIG: philologist and antiquary; b. at Gersdorf, near Löbau, Saxony, Oct. 5, 1802; studied at Leipzig and Jena. He became Professor of German at Zurich in 1833, and gained distinction by his researches in mediæval German literature. He produced an epic poem called *Deutsche Stammkönige* (1844), and *Lexicon anglo-saxonicum* (1852). He also edited the works of several old German poets. D. in Zurich, Apr. 15, 1877.

Et'trick: a pastoral vale in Selkirkshire, Scotland; extends along the Ettrick river, which, after a course of 28 miles, enters the Tweed 2 miles below Selkirk. It is remarkable for beautiful scenery. Ettrick Forest, a royal hunting tract, included all Selkirkshire. It is nearly divested of trees. JAMES HOGG (*q. v.*), the poet, called the "Ettrick Shepherd," was born in the vale and parish of Ettrick, which was also the haunt and residence of the famous freebooter Adam Scott, the King of the Border.

Etty, WILLIAM: figure-painter; b. in York, England, Mar. 10, 1787; pupil of Royal Academy, London, and of Sir Thomas Lawrence; Royal Academician 1828. He painted the nude successfully. His pictures are agreeable in color. *Head of a Cardinal* (1844) is in the South Kensington Museum; four works, including *Bather* (1844), National Gallery, London. D. in York, Nov. 13, 1849. W. A. C.

Etymology [from Gr. *ἐτυμολογία*: *ἔτυμον*, the true or original sense of a word (*ἔτυμος*, true) + *λόγος*, discourse]: that department of scientific grammar which concerns itself with the history of individual words both as to form and signification. In the common usage of the ordinary descriptive grammar, however, the term is applied to that part of the grammar which deals with modifications in the form of words, i. e. with inflexion and derivation. The etymology of scientific grammar seeks to reconstruct the primitive form and meaning of words by tracing their earlier forms and values and by comparison of cognate languages or dialects, or at least in case of later formations to determine their connection as derivatives or compounds with primitive word-forms or with groups of word-forms united severally in the possession of a common element known as the root. The tracing of earlier recorded forms includes the many cases in which a word can be followed into the territory of another language from which it has been borrowed.

Prior to the establishment in the nineteenth century of the science of comparative philology, etymology was little better than learned guesswork. It relied merely upon striking resemblances of form or meaning, and lacked entirely the restraints of definite critical tests. With the progress of the science the tendency has been to apply with increasing rigidity the tests of phonetic law, which seems to offer the only safe basis for estimating the correctness of an etymology.

The natural tendency of the mind to associate resemblance of signification with resemblance of form in words produces the manifold phenomena of folk-etymology. This association betrays itself most commonly in changes of form, accommodating the word to its presumed etymon, as *female* for *femele* (cf. *male*), *sparrow-grass* for *asparagus*, but also in mental groupings, such as *cutlet* with *cut*; cf. Palmer, *Dictionary of Folk-etymology*; Andresen, *Deutsche Volksetymologie.*

The etymology of a word even when certainly known is not directly applicable in determining the form or use of that word in current speech. The earlier meaning of the word is no "truer" than the later. Etymology is not, as the ancients thought and as its name implies, a search for the "true" meaning, but for the *history* of meaning and use as well as form. The information conveyed by an etymology is therefore to be historically and not directly applied. It shows how a word has come to be what it is, and makes it intelligible in its historical relations and according to the creative conditions of its existence.

English etymology is specially treated in the etymological dictionaries of Skeat and Müller, and excellent etymological notes are found in Murray's and Webster's (*International*) English dictionaries. For a list of etymological dictionaries, see DICTIONARY. BENJ. IDE WHEELER.

Eu, ö (Lat. *Au'ga*, or *Augium*): town of France; department of Seine-Inférieure; 17 miles E. N. E. of Dieppe and 2 miles from the sea (see map of France, ref. 2–E). It has a fine Gothic church, and manufactures of lace, silk, and soap. Here is the château d'Eu, which was owned by King Louis Philippe, and is surrounded by a large and beautiful park. It contains a portrait-gallery, which is said to be the finest collection of historical portraits in France. Pop. (1896) 4,818.

Eu, PRINCE LOUIS PHILIPPE MARIE FERDINAND GASTON D'ORLÉANS, Comte d': general; b. at the château of Neuilly, Apr. 28, 1842; the eldest son of the Duc de Nemours, and a grandson of Louis Philippe, King of the French. In 1864 he married Isabella, daughter of Dom Pedro II., Emperor of Brazil. As marshal of the empire he took command of the allied forces operating against Paraguay, and Mar. 1, 1870, the war was ended by the death of the dictator Lopez, who was killed in a battle at Aquidubon. He was commander-general of the Brazilian artillery from 1865 to 1889, but when the revolution of the latter year deposed Dom Pedro, Comte d'Eu accompanied him to Europe, and afterward resided at Versailles, France.

Eubœ'a, or **Negropont** (in Gr. Εὔβοια; Fr. *Eubée*; Turkish, *Egripo*, or *Egripos*; Ital. *Negro'ponte*): a Greek island; the largest island in the Ægean Sea. It is about 90 miles long, and the greatest breadth is about 30 miles. Area, 1,574 sq. miles; with the Sporades islands (forming a nomarchy of the kingdom of Greece), 2,216 sq. miles. It is separated from the northeast coast of Attica and Bœotia by the narrow channels of Egripo (*Euri'pus*) and Talanta. It is connected with the mainland of Bœotia by a bridge across the channel at Chalcis. The surface is mountainous. Mt. Delphi, near the middle of the island, is said to be 7,266 feet high. It is of limestone formation. The soil of the valleys is fertile, and produces cotton, wheat, grapes, etc. Among the exports are wool, hides, and oil. The chief towns are Chalcis and Carystus. In ancient times Eubœa belonged to the Athenian republic. Pop. of nomarchy (1896) 115,515.

Eubu'lides (in Gr. Εὐβουλίδης): a Greek philosopher of the Megaric school; flourished about 350 B. C. He was a native of Miletus, a disciple of Euclid, and an opponent of Aristotle.

Eubu'lus (in Gr. Εὔβουλος): an Athenian comic poet of the middle comedy; flourished about 375 B. C. He wrote numerous comedies on mythological subjects, of which only small fragments are extant. Fragments in Meineke's and Kock's collections.

Eucalyp'tus [from Gr. εὖ, well + καλυπτός, covered]: a genus of trees of the family *Myrtaceæ*, comprising 100 or more species, mostly natives of Australia. As a common name the plural is eucalypti. They form a characteristic feature of the peculiar vegetation of Australia, having entire leathery leaves, of which one edge is directed toward the sky, so that both surfaces are equally exposed to the light. The eucalypti are called gum-trees, because they abound in resinous exudations. The timber is excellent, and is used for ship-building and other purposes. The *Eucalyptus obliqua*, called stringy bark, attains a height of 150 to 250 feet, and is said to reach occasionally 400 to 500 feet, but this needs confirmation. The bark of several species abounds in tannin, and is used for tanning leather. The *Eucalyptus resinifera*, which grows to a great height, yields a red astringent gum, which is called "Botany Bay kino," and is used in medicine as a substitute for kino. An exudation resembling manna in medicinal properties is obtained from the leaves of *Eucalyptus viminalis* and *dumosa.* The blue gum (*Eucalyptus globosa*) produces ship-timber of the best quality. It is said to furnish a febrifuge principle surpassing quinia in efficiency. Several species of eucalyptus have been successfully introduced into California and Europe. See VICTORIA (*Flora and Fauna*).

Eucharist [from Gr. εὐχαριστία, thanksgiving; εὖ, well + χάρις, favor, thanks]: the sacrament of the Holy Communion, or the feast of the Lord's Supper; so called in allusion to the blessing and thanksgiving with which the last supper of our Saviour with his disciples began and ended. This solemn festival has been kept in all Christian churches from the time of the resurrection, in commemoration of the passion and death of our Lord, and in obedience to his own divine institution. Among the earliest disciples in Judæa, the Lord's Supper seems to have been a regular meal, probably the principal meal of the day in each family, into which the commemorative breaking of bread and partaking of the cup of blessing were introduced as a part. Subsequently the disciples of many families came together and held a festival in common—a practice in which originated the ἀγάπη, or love-feast, in the course of which the brethren saluted each other with a holy kiss. The abuses which grew out of this, and which are severely rebuked by St. Paul in the First Epistle to the Corinthians, led to a separation of the two institutions; and the commemorative observance has since been celebrated, with a solemnity in harmony with its character, by itself.

No part of the Christian practice and doctrine has given rise to larger diversities of opinion or to a more voluminous polemical literature than the sacrament of the Eucharist. Irenæus (*Hæres.*, iv. 18, 5) indeed says that the bread after the Epiclesis is no longer common bread but eucharistia, consisting of two parts, an earthly and a heavenly. But to be wise above what is written was not the temper of the early Church. There was no attempt to explain what has since been called the "real, spiritual presence" of the Lord in the consecrated elements of bread and wine. And so with Justin Martyr. Writing of the Holy Communion, he expresses simply, and in words such as might be used to-day, the view of this great mystery which he in common with those of his day believed: "This food is called among us *Eucaristia*. . . . For not as common bread and common drink do we receive these; but in like manner as Jesus Christ our Saviour, having been made flesh by the word of God, had both flesh and blood for our salvation, so likewise have we been taught that the food which is blessed by the prayer of his word, and from which our blood and flesh by transmutation are nourished, is the flesh and blood of that Jesus who was made flesh" (2 *Apol.* lxvi.). The metaphysical controversies on this subject were not known to the Church during its first eight or nine centuries. It seems entirely just to believe that, during all this early period, the visible elements employed in the celebration, the consecrated bread and wine, were regarded chiefly as symbols and emblems of the body and blood of Christ given for our redemption; inasmuch as the expression of an opinion or doctrine different from this appears to have been first publicly made in the year 831 by a monk, subsequently abbot of Corbey, in France, named Pascasius Radbert, who maintained the two following propositions, which he declared to be the true doctrine of the Church, but which were received with loud and general remonstrance; viz., first, that, "after the consecration of the bread and wine in the Lord's Supper, nothing remains but the outward figure, under which the body and blood of Christ are really and locally present"—that is to say, the doctrine more recently known under the name of *transubstantiation*; and secondly, that "the body of Christ thus present in the Eucharist is the same body that was born of the Virgin, that suffered on the cross, and that was raised from the dead." The excitement which followed this announcement was such that the Emperor of Germany, Charles II. (I. of France, called "the Bald"), directed counter-expositions to be prepared by Johannes Scotus and Ratramn (otherwise called Bertramn). The work of Scotus, though often cited in subsequent centuries, has perished; that of Ratramn is still extant. Both held that the consecrated bread and wine in the Eucharist are only signs or symbols, and not the veritable body and blood of Christ; but in the work of Ratramn there are some things said on this point which are ambiguous or obscure, while Scotus, on the other hand, is said to have been perspicuous, distinct, and intelligible. Out of this dispute arose some extraordinary and repulsive secondary controversies, as to the natural consequences of taking into the stomach and digesting the consecrated elements, whatever view be taken of their nature, for which those who desire to understand them must refer to the ecclesiastical histories.

The doctrine of Pascasius, or at least his first proposition, found no small number of adherents, but the struggle, though warm, was a struggle of private opinions, and not of opinions with authority. The Church set forth no definition of her own views on the subject, and the excitement after a time abated. About two centuries later, however, the controversy was renewed in a manner which presently led to the interposition of the Roman pontiffs, and subsequently of councils of the Church. The first incident in this renewal was a declaration, in 1004, by Leutheric, Archbishop of Sens, to the effect that none but the sincerely pious receive the body of Christ in the Holy Communion. It is easy to see what questions may arise out of a doctrine like this, especially with those who hold the certainty of the real presence. Later, in 1045, the celebrated Berengarius, at that time Archdeacon of Angers, taking the work of Johannes Scotus, above mentioned, as his text and guide, attacked with vehemence the doctrine of the real presence. He was met by Bruno, his own bishop (of Angers), and also by Hugh of Langres and Adelman of Bresse. But his most powerful and most dangerous antagonist was the pope, Leo IX., who assembled two councils in 1050—one at Rome and one at Vercelli—where he caused the writings of Berengarius to be condemned and burned, and excommunicated their author. Retiring into Normandy, Berengarius sought the support of William (afterwards "the conqueror" of England), but this prince having convened an assembly of the principal prelates and theologians of his province, the unfortunate polemist was again condemned; and in the Council of Paris, called by Henry I. in the same year (1050), he was not only condemned still a third time, but deprived of his benefices. The subsequent history of Berengarius is a painful one. On three different occasions, under three different successive popes, Victor II., Nicholas II., and Gregory VII., he was compelled by threats and intimidation to renounce his opinions; and on two of these occasions to subscribe to declarations drawn up for him by his enemies. The first of these declarations, made at what may be called his second trial, under Nicholas II., was to the effect that "the bread and wine after consecration are not only a sacrament, but also the real body and blood of Jesus Christ; and that this body and blood are handled by the priests and consumed by the faithful, and not in a sacramental sense, but in reality and truth, as other sensible objects are." He was not only forced to subscribe to this declaration, but also to confirm it with an oath; but hardly had he returned to France before he abjured it utterly, and resumed the teaching of his former views. He was accordingly arraigned a third time, and this arraignment took place under Gregory VII. (Hildebrand), who seems himself not to have partaken of the extreme views of Berengarius's relentless persecutors, yet to have felt compelled to oblige him to renounce his own. The unfortunate man constrained himself consequently to subscribe to his belief of the following proposition, and to confirm this declaration by an oath—viz., that "the bread laid on the altar becomes, after consecration, the true body of Christ, which was born of the Virgin, suffered on the cross, and now sits at the right hand of the Father; and the wine placed on the altar becomes, after consecration, the true blood which flowed from the side of Christ." There was affirmed to be an ambiguity in this declaration, perhaps growing out of the construction to be put upon the words "laid, or placed, upon the altar." At any rate, it did not satisfy the enemies of Berengarius, and he was therefore subjected to the humiliation of subscribing and making oath to still another confession of faith, in the following words—viz., that "the bread and wine are, by the mysterious influence of the holy prayer and the words of our Redeemer, substantially changed into the true, proper, and vivifying body and blood of Jesus Christ"; to which was added, that "the bread and wine are, after consecration, converted into the real body and blood of Christ, not only in quality of external signs and sacramental representations, but in their essential properties and substantial reality." This form of submission having been fully completed, Pope Gregory dismissed the humble prelate with many marks of personal esteem, and visible and liberal evidences of his friendship. Notwithstanding which, no sooner was Berengarius in his own country again, than he retracted this last declaration, as he had done all the former, and prepared an elaborate refutation of the doctrines to which he had just subscribed. The pope took no notice of this retractation, whence the inference has been drawn that Gregory himself was personally not far from entertaining the same opinions as Berengarius. The evening of the days of this greatly tried champion of the right to freedom of opinion where the Church has not spoken was passed in acts of penance and mortification, to which he subjected himself in expiation of the guilt of his dissimulation and perjury at Rome.

It was not till the assembling of the fourth Lateran Council by Innocent III., in the year 1215, that the voice of the Roman Church was authoritatively uttered as to the true doctrine of the Eucharist. That pope, through a decree of that council, declared the true faith to be that the elements of bread and wine are really and truly, after consecration, the body and blood of Jesus Christ in actual substance, remaining bread and wine only to outward appearance; and he himself invented and introduced the term "transubstantiation," by which this doctrine has been ever since known and recognized as a doctrine of the Roman Church. It was a natural consequence of the admission of this doctrine as an established dogma that that view of the Eucharist which regards the ceremonial consecration and placing upon the altar of the elements as a *sacrifice*, in which the original great sacrifice upon Calvary is perpetually renewed, found easy acceptance; and other consequences have been the worship of the consecrated elements, as being a worship directly paid to Christ himself; the elevation of the Host in the celebration of mass, that it may be seen and reverenced by the people; and the custom, prevalent in Roman Catholic countries, of carrying this consecrated bread about in solemn processions through the public streets, to be administered to the sick and dying.

Another controversy in regard to the Eucharist arose in the sixteenth century, which continues still to divide opinions, the Church not having formally declared on either side. It was (and is) held by the Jesuits and Dominicans, that the sacraments have in themselves an instrumental and efficient power by virtue of which they work in the soul, independently of any previous preparation or state of the propensities, a disposition to receive the divine grace; and this they call the *opus operatum*. Thus, according to their view, neither knowledge, nor wisdom, nor humility, nor faith, nor devotion is necessary to the efficacy of the sacraments, whose prevailing energy nothing but a mortal sin can resist. Hence, therefore, according to them, priests may give immediate absolution to all who confess their misdeeds and evil thoughts and wicked sentiments and propensities, and admit them directly to the use of the sacraments. This view was resisted by the Jansenists, and is rejected by all in the Roman communion who have the progress of vital and practical religion truly at heart. These demand that none shall be admitted to the sacrament of the Holy Communion who do not give evidence of true penitence, and of an intent henceforth to lead a new life, following the commandments of God, and walking in his holy ways.

The same century saw the great uprising against the abuses which had gradually crept into the Church of Rome, commonly called the Reformation, inaugurated by the monk Martin Luther. It soon appeared that, upon some essential points of doctrine, there was as little harmony of doctrine in the ranks of the Reformers as there had been in those of the Church. In regard to the Eucharist, the difference between Luther and Zwingli, if not quite so wide, was at least as irreconcilable as that between the Jesuits and the Jansenists, or that of the ninth century between Radbert and Scotus. Luther maintained that the body and blood of Christ are really, though in a manner far beyond human comprehension, present in the Eucharist, and are exhibited together with the bread and wine. This is the doctrine since known as "consubstantiation." Zwingli, on the other hand, regarded the bread and wine as being only symbols present, and typifying the body and blood of Christ, which themselves are absent. Numbers of zealous and able men enrolled themselves in this controversy, on both sides, and the consequent danger to the common cause of Protestantism was such that Philip, Margrave of Hesse, whose devotion to this cause was deep and sincere, appointed a conference to be held at Marburg, between Luther, Zwingli, and other doctors of both parties. The result, so far as the main point is concerned, was a failure. The two great leaders separated without either having been able to convince the other, and without having been able to agree upon any statement of doctrine in regard to Christ's presence in the Eucharist which both could accept.

The doctrine of the Anglican Church, which is that of the Protestant Episcopal Church in the United States on this subject, is briefly set forth in the catechism, where, after defining a sacrament to be an outward and visible *sign* of an inward and spiritual grace, and affirming the object for which the sacrament of the Lord's Supper was ordained to have been "for the continual remembrance of the sacrifice of the death of Christ, and of the benefits which we receive thereby," it is declared that in this sacrament the outward and visible part or sign is the "bread and wine which the Lord hath commanded to be received," and that the thing signified is "the body and blood of Christ, which are spiritually taken and received by the faithful in the Lord's Supper." And in the "Articles of Religion, as established by the bishops, clergy, and laity of the Protestant Episcopal Church in the United States of America, in convention, on the 12th day of September, in the year of our Lord 1801," which are, with some alterations of minor importance, identical with the Thirty-nine Articles of the Church of England, it is declared (in "Art. xxviii.; of the Lord's Supper") that "transubstantiation (or the change of the substance of the bread and wine) in the supper of our Lord can not be proved by Holy Writ; but is repugnant to the plain words of Scripture, overthroweth the nature of a sacrament, and hath given occasion to many superstitions." And further, "that the body of Christ is given, taken, and eaten in the Supper, only after an heavenly and spiritual manner. And the mean whereby the body of Christ is received and eaten in the Supper is faith." For the Roman Catholic doctrine on Eucharist, see MASS. Revised by W. S. PERRY.

Euchee: See UCHEAN INDIANS.

Euchlorine [from Gr. εὖ, well + χλωρός, green + suffix *-ine*]: a green gas liberated when potassic chlorate is acted upon by hydrochloric or sulphuric acid. It possesses bleaching properties. It is prepared by heating gently a mixture of two parts of sulphuric acid, two of water, and one of chlorate of potash. It has been shown to be a mixture of chlorine dioxide, ClO_2, and chlorine.

Revised by IRA REMSEN.

Euchre [orig. spelled *uker* or *yuker*; etymology unknown]: a game at cards played with a pack containing only the aces, kings, queens, knaves, tens, nines, eights, and sevens. These rank in the order named, except that in the trump suit the knave, called *right bower*, is highest, while the knave of the *next* suit (i. e. the one like the trump suit in color), called *left bower*, is considered as belonging to the trump suit instead of its own, and ranks there next below the right bower and next above the ace. Ordinarily, four persons play, partners sitting opposite each other. After shuffling and cutting five cards are dealt each player, from left to right, two the first time round and three the second, or *vice versa*, and the next card is turned face up. Then the eldest hand (i. e. the player at the dealer's left) either *orders up* this card or *passes*. By ordering it up he makes the suit trump, and the dealer must take the card in exchange for one in his hand. If he passes instead, the next player (the dealer's partner) has the same option, and so on until, if the card has not been ordered up, the dealer himself has the option of taking it up, thus making it trump, or of turning it down, in which case the players, in the same order, exercise the option of again passing or of naming as trump any suit except that of the card thus turned down. If no one is willing to make trump the hand is thrown up and the deal passes on to the next player to the left, just as it would if the hand were played. An apparent exception to the above is that the dealer's partner is always said to *assist* instead of ordering up. The player making the trump, if he announces his intention to do so before a card is led, may *play alone*, i. e. without the aid of his partner, who in this case turns his cards face down and remains silent while the other three play out the hand. If the person who makes trump does not play alone, the privilege may be exercised only by the partner of the eldest hand when the latter makes the trump, and by the dealer when his partner makes it.

When the trump has been made the eldest hand leads a card, and each other player in turn plays one to it. The four cards constitute a trick, which is taken by the highest card of the suit led, unless it contains one or more trumps, when it is taken by the highest of these. The winner of one trick leads for the next. A player must always follow suit if he has it; otherwise he may play any card he chooses. The game is won by the side first scoring five points. The side making trump scores two points by taking all five tricks (a *march*), or one point by taking either three or four. If they take less than three tricks they are *euchred*, and the opposing side scores two points. A player who plays alone scores for his side in like manner, except that a march counts four; if he is euchred the opposite side scores two.

Euchre is played by two persons just as by four, with the omission of the features distinctive of the latter, as the difference in scoring when a hand is played alone. When three play, in each hand the person making trump plays against the other two, each of whom scores two if they secure a euchre; a march counts three. With modifications as regards selecting trump and scoring, five or even six persons may play. There are many popular variations even in the game for four: quite commonly the eights and sevens are omitted from the pack; sometimes a blank card is included and stands as the highest trump of any suit; with some a person playing alone takes his partner's strongest card in exchange for one of his own; but these and other modifications are made only by previous agreement. S. A. T.

Euclase [from Gr. εὖ, well + κλάσις, fracture, deriv. of κλάειν, to break]: an exceedingly rare variety of silicate of beryllium found in Brazil and the Ural Mountains, occasionally used as a gem.

Euclid (in Gr. Εὐκλείδης) OF ALEXANDRIA: a Greek mathematician, called the "father of geometry." He was born in Alexandria in Egypt, and lived about 300 B. C., and is said to have belonged to the Platonic school of philosophy. The events of his life are mostly unknown, except that he taught mathematics in the reign of Ptolemy I. (Soter), who died about 282 B. C. He made important discoveries in geometry, and surpassed all preceding geometers in the rigorous method and arrangement of his demonstrations. When Ptolemy I. asked him if geometry could not be mastered by an easier process than the ordinary one, he returned the celebrated answer, "There is no royal road to geometry." His *Elements of Geometry* presents the most ancient system of that science that is extant, and has been considered an excellent standard work for 2,000 years. See Smith's *Dictionary of Greek and Roman Biography.*

Euclid OF MEGARA: a Greek disciple of Socrates; flourished about 400 B. C. He is said to have witnessed the death of Socrates (399 B. C.), after which he founded at Megara a school called the Megaric or Dialectic. His system was based on or partly derived from the principles of the Eleatic school, to which he added the ethics of Socrates.

Eude'mus (in Gr. Εὔδημος) OF RHODES: a disciple of Aristotle and author or editor of the *Eudemian Ethics* in seven books, published among Aristotle's works. Fragments of his other writings in Mullach, *Fragmenta Philosophorum Græcorum*, vol. iii., pp. 222–292. B. L. G.

Eudiom'eter [from Gr. εὔδιος, clear, fair (weather) + μέτρον, measure]: an instrument originally intended for ascertaining the proportion of oxygen in the air, with a view of judging of its purity or impurity; but it is also employed to test the composition of any mixed gases. Many forms have been used, but one of the best consists of a graduated glass tube having two platinum electrodes within it, the tube closed at one end. To test the composition of air, for example, the carbon dioxide (carbonic acid) of the air within the tube is removed by strong liquor potassæ over a mercury bath, when the rise of the mercury within the tube indicates the proportion of carbon dioxide in the atmosphere. A large but determinate proportion of hydrogen is then introduced and exploded by means of the electrodes. After cooling, one-third of the loss of gas by explosion is the volume of free oxygen in the tube. Allowing for the hydrogen unconsumed, the volume of nitrogen is readily seen. The results are then reduced to a percentage of volumes.

Eudo'cia (in Gr. Εὐδοκία; Fr. *Eudocie*), sometimes called **Eudoxia**: the wife of Theodosius II.; b. in Athens about 393. She was a daughter of the sophist Leontius, and her name before she was converted to Christianity was Athenaïs. She was very carefully educated and thoroughly conversant with Greek literature and philosophy; she had even studied the sciences. A quarrel with her brothers about the inheritance after her father's death brought her to Constantinople, where she wished to lay her case before the emperor. Theodosius was completely captivated by her beauty and her accomplishments, and in 421 he married her, she having in the meantime embraced Christianity. In 438 she made a pilgrimage to the Holy Land, imitating, in a rather ostentatious manner, the Empress Helena, the mother of Constantine the Great, and distributing enormous sums as alms and donations for pious purposes. Shortly after her return an estrangement took place between her and her husband, some imprudence upon her side having aroused his jealousy, and in 449 she was banished from the court. She settled in Jerusalem, and devoted herself entirely to the study of Christian theology and to religious exercises. She died there in 460. She wrote paraphrases in heroic verse of the Octateuch, Daniel, and Zechariah, and a poem on the martyrdom of Cyprian, etc. See F. Gregorovius, *Athenais* (1882).

Eudox'us (in Gr. Εὔδοξος): a Greek astronomer; b. at Cnidos in Caria; flourished about 366 B. C. He was a pupil of Archytas and of Plato, and he opened a school at Athens or Cnidos. Cicero called him the prince of astronomers. Eudoxus computed the length of the year to be 365¼ days, and appears to have originated the doctrine of concentric solid crystalline spheres, by which he explained the apparent motions of the sun, moon, and planets. He is frequently referred to by ancient writers.

Eufaula, yu-faw'la: city and railway junction; Barbour co., Ala. (for location of county, see map of Alabama, ref. 6–E); 80 miles E. S. E. of Montgomery; on the right bank of the Chattahoochee river, which is navigable to this point for its largest boats at all seasons. The city is a winter health resort, and has a college for young women, a school for colored people, a bagging-factory, several cotton-warehouses, a fair-ground, water-works, etc. Over 50,000 bales of cotton are sold here annually. Pop. (1880) 3,836; (1900) 4,532.

Eugene: city; capital of Lane co., Ore. (for location of county, see map of Oregon, ref. 4–B); 71 miles S. of Salem; on railway and on the west bank of the Willamette river, which is navigable for steamboats during several months of the year. It is the business center of the upper Willamette valley, and the educational center of the State. It contains the University of Oregon, located here by act of the Legislature in 1872, a fine Masonic temple, a large flouring-mill, steam saw and planing mills, furniture-manufactory, and a woolen-mill. Pop. (1880) 1,117; (1900) 3,236.

EDITOR OF "OREGON STATE JOURNAL."

Eugene, yu-jeen' (in Fr. *Eugène*; Germ. *Eugen*), PRINCE, or, more fully, **François Eugène de Savoie**: general; b. in Paris, Oct. 18, 1663. He was a son of Eugène Maurice, Count of Soissons, and Olympia Mancini, a niece of Cardinal Mazarin. Having been offended by Louis XIV.'s refusal to grant him a commission in the army, he entered the service of the Emperor of Austria in 1683. He served with distinction in the war against the Turks, and was rapidly promoted. In 1691 he obtained command of the imperial army in Piedmont, where he fought against the French. Louis XIV. afterward offered him a marshal's bâton if he would enter the French service, but he declined. Having been appointed commander of the Austrian army in Hungary, he gained a decisive victory over the Turks at Zenta Sept. 11, 1697. In the great European war of the Spanish succession, which broke out in 1701, Eugene first commanded in Italy, where he was opposed by the able French marshal Catinat, and afterward by Villeroi, whom he surprised at Cremona and took prisoner in Jan., 1702. An indecisive battle was fought at Luzara in Aug., 1702, by Prince Eugene and the Duke of Vendôme. About the end of that year he was appointed president of the council of war in Vienna. He commanded the imperial army which co-operated in Germany with the English army under the Duke of Marlborough. These allies defeated the French and Bavarians at the great battle of Blenheim, Aug. 13, 1704. In 1705 he took command of the army in Italy, and was defeated by the Duke of Vendôme at Cassano in August of that year. He gained a victory over the Duke of Orleans at Turin in Sept., 1706, expelled the French from Italy, and returned to Vienna in 1707. The seat of war was next transferred to Flanders, where Prince Eugene was associated with the Duke of Marlborough in the command of the combined armies. They defeated the French at Oudenarde (1708), and claimed the victory at the great battle of Malplaquet (Sept. 11, 1709), where they remained masters of the field but lost about 25,000 men. In 1712 he was sent to London on a diplomatic mission, the object of which was to persuade the English to continue the war and to restore Marlborough to the command, but he was not successful. A victory which Marshal Villars gained over the Dutch allies of Prince Eugene at Denain in July, 1712, induced Austria to negotiate for peace. In Mar., 1714, he signed a treaty of peace at Rastadt. He defeated a large Turkish army at Peterwardein Aug. 5, 1716, and took Belgrade from the same enemy in 1717. After the end of this war, in 1718, he rendered important services as a statesman, and enjoyed the confidence of the Emperor of Germany. D. in Vienna, Apr. 21, 1736. See John Campbell, *Military History of Prince Eugene and Marlborough* (2 vols., 1736), and Von Sybel, *Prinz Eugen von Savoyen* (London, 1868).

Euge'nia: a genus of trees and shrubs of the family *Myrtaceæ*, nearly related to the myrtle. It comprises numerous species, which are natives of tropical and subtropical countries, and some of them produce delicious fruits remarkable for their pleasant balsamic odors. The fruit is a berry of one or two cells, with one seed in each cell. The *Eugenia malaccensis*, a native of the Malayan Archipelago, is a small tree which bears a red fruit nearly as large as an apple, with a juicy pulp and an agreeable odor like that of a rose; hence it is called rose apple. The last name is also applied to the fruit of the *Eugenia jambos*, an East Indian tree, now cultivated extensively in many tropical countries. Florida has five or more unimportant species.

Eugénie, ö'zhā'nee', or **Eugénie Marie de Montijo**, de-mōṅ'tee'zhō: ex-Empress of the French; b. in Granada, Spain, May 5, 1826. Her father was the Spanish Count de Montijo, and her mother was Maria Manuela Kirkpatrick, who was of Scottish extraction. Eugénie was styled the Countess of Teba in her youth. She was married to Napoleon III., Jan. 30, 1853, and bore a son Mar. 16, 1856. As a zealous Roman Catholic she used her influence to promote the power of the pope. She acted as regent in 1859 when Napoleon was in Italy, in 1865 during his Algerian tour, and again in the interval between his departure for the seat of war, July 23, 1870, and the proclamation of a republic by the people of Paris, Sept. 4, 1870. She then escaped to England under the protection of M. de Lesseps, and resided at Chiselhurst, afterward removing to Farnborough. The constant litigation to which her claims against the French Government gave rise, and her frequent visits to the Continent, kept her name before the public. The latter years of her life have been greatly saddened by the death of the young prince imperial, June 1, 1879. Eugénie is the author of *Some Recollections from My Life* (1885).

Euge'nius: Bishop of Toledo from 646–57; a writer of Latin poems on a great variety of subjects in various measures, including some acrostics and telestichs. (See DRACONTIUS.) The poems were edited by Sirmond (Paris, 1619), and by Migne in vol. lxxxvii. of the *Patrologia Latina*. A new ed. by R. Peiper is promised for the Vienna Corpus SS. eccl. lat.

M. W.

Eugenius I.: pope; consecrated Aug. 10, 654 A. D., as the successor to Martin I., who was banished by the Emperor Constans. D. June 1, 657.

Eugenius II.: a native of Rome; succeeded Pascal I. as pope in June, 824 A. D. He called a council, which met at Rome in 826 for the reformation of the clergy. D. Aug. 27, 827, and was succeeded by Valentinus.

Eugenius III. (BERNARD PAGANELLI): a native of Pisa; was chosen pope Feb. 15, 1145, in place of Lucius II. The Romans, excited by the preaching of Arnaldo da Brescia, had revolted against Pope Lucius. Eugenius, being unable to enforce his authority, retired to France and held a council at Rheims in 1148. He also promoted the second crusade. D. July 8, 1153, and was succeeded by Anastasius IV.

Eugenius IV. (Gabriele Condolmiere): pope; b. in Venice, 1383; was crowned pope Mar. 3, 1431, as successor of Martin V., who had convoked a council at Basel. This council refused to recognize the supremacy of the pope. Eugenius therefore issued a bull proclaiming that the Council of Basel was or must be dissolved, and he called another council at Ferrara in 1438. The Council of Basel in 1438 deposed the pope, and elected as his successor Amadeus of Savoy, who assumed the name of Felix V. The result of this election was a schism in the Church, for Eugenius continued to act as pope in Rome, and was recognized by several powers. In 1439 the sessions of the council were transferred to Florence. Eugenius and John Palæologus signed in 1439 a convention for the union of the Greek and Latin churches, but this convention had no permanent effect. D. in Rome, Feb. 23, 1447.

Eugip'pius: abbot of Lucullanum, near Naples; b. at Carthage about 450; educated at Rome; in the beginning of sixth century made a collection of excerpts from the works of St. Augustine, and composed in 511 an admirable life of St. Severinus, which is very valuable for the light which it throws upon the customs and life of the Germans of that period. The best edition is by P. Knoell (2 vols., Vienna, 1885–86). M. W.

Eugraph'ius: a Latin grammarian, probably of the sixth century, whose commentary on the plays of Terence is extant, and may be found with the commentary of Donatus in Klotz ed. of Terence (2 vols., Leipzig, 1838–40). See H. Gerstenberg, *De Eugraphio Terentii interprete* (Jena, 1886). M. W.

Eugu'bian Tables: certain bronze tablets found near Gubbio (the ancient *Iguvium*) in 1444. Five of the inscriptions are in Etruscan and Umbrian characters, the other two in Latin. They were published by Lepsius in his *Inscriptiones Umbricæ et Oscæ* (1841), and contain the acts of a corporation of priests.

Euhe'merus: a Greek philosopher of the third century B. C.; the founder of Euhemerism, or that principle of interpreting the pagan mythology according to which each myth is supposed to have originated from some simple historical event. This method of interpretation, which earned for the author the surname "Atheist," was introduced into Rome by Ennius, and eagerly employed by the Fathers of the Church to discredit pagan mythology. The works of Euhemerus have perished.

Eulachon: See Oulachan.

Eulenburg, oi'len-boorkh, Friedrich Albrecht, Graf von: Prussian statesman; b. June 25, 1815; went in 1859 as envoy to China, Japan, and Siam; concluded a treaty of amity and navigation with Japan, Jan. 1, 1861, and in September of the same year another with China; became in 1862 Minister of the Interior. D. near Berlin, June 2, 1881.

Eu'ler (Germ. pron. oi'ler), Leonard: geometer; b. at Basel, Switzerland, Apr. 15, 1707. He was educated at the university of that city, and went to St. Petersburg with his friend Daniel Bernoulli. In 1733 he became Professor of Mathematics in the Academy of St. Petersburg. He displayed great fecundity and inventive genius by the composition of a multitude of treatises on mathematics. It is said that he wrote more than half of the forty-six quarto volumes published by the Academy between 1727 and 1783. Having been invited by Frederick the Great, he removed to Berlin in 1741. He improved the integral calculus and the science of mechanics. Among his numerous works are *Mechanics, or the Science of Motion analytically explained* (in Latin, 2 vols., 1736–42); a *Treatise on Naval Science* (1749); *Institutiones Calculi Integralis* (Treatise on Integral Calculus, 1768); *Letters to a German Princess* (in French, 1768); a *Treatise on Dioptrics* (1771); and *Theory of the Moon's Motion* (1772). He became blind about 1767, after which he resided in St. Petersburg until his death, Sept. 7, 1783. Condorcet, who wrote a eulogy on him, says, "He multiplied his productions marvelously, and yet was original in each."

Eu'menes (in Gr. Εὐμένης): a favorite officer of Alexander the Great; b. at Cardia, in Thrace, about 360 B. C. He had a high command in the army which Alexander conducted against Persia in 334 B. C., and gained the confidence of that prince. On the death of Alexander, Eumenes became governor of Cappadocia and Pontus. As an ally of Perdiccas he defeated Craterus in the year 321, soon after which Antigonus and Antipater formed a coalition against him. Eumenes was captured and put to death by Antigonus in 317 or 316 B. C. See Plutarch, *Life of Eumenes.*

Eumen'ides [in Gr. Εὐμενίδες; εὖ, good + μένος, mind, disposition—i. e. the gracious ones, so called for the sake of propitiating them], or **Erinnyes**: the Greek name of the Furies, whom the Romans called Furiæ or Diræ. They were supposed to be goddesses who punished crimes and pursued the guilty with burning torches. According to the later tradition, there were three Furies—namely, Tisiphone, Alecto, and Megæra. The Cave of the Eumenides is at the N. E. angle of the Areopagus, at Athens, immediately below the seats of the judges.

Eumol'pus (in Gr. Εὔμολπος): in the Greek mythology, a Thracian bard, son of Neptune, and the founder of the Eleusinian mysteries. Musæus is said to have had a son named Eumolpus, who was an instructor of Hercules.

Euna'pius (in Gr. Εὐνάπιος): a sophist and physician; b. at Sardis, in Lydia, about 348 A. D. He was a Neoplatonist, an opponent of Christianity, and a partisan of Julian the Apostate. He lived at Athens, and wrote in Greek *The Lives of Philosophers and Sophists*, which is interesting and important for the view which it gives of the intellectual life of the times. Ed. by Boissonade in 1822. D. about 420.

Euno'mius (in Gr. Εὐνόμιος): the founder of an Arian sect called Eunomians; b. at Dacora, in Cappadocia, in the early part of the fourth century. He was appointed Bishop of Cyzicus in 360 A. D. by Eudoxius, Bishop of Antioch, who four years afterward deposed him for heresy. Eunomius was a man of superior abilities, and maintained the extreme Arian doctrines. For him Christ was neither of the same nor like substance with the Father, but essentially and substantially different. This was his peculiar teaching, for which he was several times banished. D. at Dacora soon after 392 A. D. His followers, the Eunomians, were for some time very numerous, but the sect died out in the fifth century. Revised by J. W. Chadwick.

Eunuch [from Gr. εὐνοῦχος, chamberlain; εὐνή, bed + ἔχειν, hold, keep]: originally, a servant who had the care of bedchambers; hence, from the custom of placing women's apartments under the care of castrated persons, any castrated male of the human species. Castration was a very ancient practice, and was especially frequent in Syria and the East. It is a natural consequence of the system of polygamy. In Greece it was not common until the Byzantine period. In Rome under the emperors many eunuchs were kept. It is asserted that they existed in considerable numbers in mediæval Europe. In Italy they were much esteemed for their fine soprano singing. Leo XIII. is said to have effected their banishment from the papal choir, where they were employed long after they had disappeared from the operatic stage. At present they are chiefly found in Mohammedan countries, and are said to come mostly from Northeastern Africa. The operation is highly dangerous, the mortality being enormous. At Moscow there is a community of eunuchs who are jewelers by profession, and who add to their numbers by the purchase and mutilation of children. Eunuchs as a class are small, beardless, and weak, of a jealous and intriguing character; yet some, like Bagoas, the Persian minister, Philetærus, King of Pergama, and Narses, the Byzantine general, have possessed energy and ability. As used in the Bible and the classics, the word often means simply a chamberlain. There is a Russian sect, known as Skopzi, which practices castration.

Euon'ymus [Lat. form of Gr. εὐώνυμος, fortunate, propitious; εὖ, well + ὄνομα, name; so called by euphemism because it is poisonous]: a genus of shrubs of the family *Celastraceæ*, natives of Europe and the U. S. The fruit is a capsule, with seeds inclosed in a red aril. The flowers, foliage, and fruit of some of the species are poisonous. The wood of the *Euonymus europæus*, an ornamental shrub, is strong, compact, and yellow, and is applied to various useful purposes. The *Euonymus atropurpureus* (burning bush, or wahoo), a native of the U. S., is an ornamental shrub, with crimson fruit drooping on long peduncles. The bark is used as a remedy for dropsy, and as a hepatic stimulant and laxative, and has active properties. The *Euonymus americanus*, or strawberry bush, is often cultivated for ornament.

Eupato'ria (formerly **Koslof**): a seaport of Russia; government of Taurida; on the Black Sea, and on the west coast of the Crimea; 38 miles W. N. W. of Simferopol (see map of Russia, ref. 11–C). It has a shallow harbor, a custom-house, a hospital, and a handsome Tartar mosque. Grain, wool, hides, and salt are exported from this place. The English and French armies landed here in Sept., 1854, and the Russians were repulsed here in Feb., 1855. Pop. 14,000.

Eupato′rium [said to have been so named from Mithridates Eupator, King of Pontus (d. 63 B. C.)]: a genus of plants of the family *Compositæ*, having the florets all tubular and perfect. It comprises many species of perennial herbs, mostly American. The *Eupatorium perfoliatum*, called boneset and thoroughwort, is a native of the U. S., and is used in medicine as a tonic, stimulant, and sudorific. The leaves, as the specific name denotes, are connate-perfoliate—i. e. united at the base around the stem. The hemp agrimony (*Eupatorium cannabinum*), which grows wild in England, has been used in medicine. The *Eupatorium purpureum* and several other American species appear to have valuable diuretic properties.

Eupen, oi′pen (in Fr. *Néau*): town of Rhenish Prussia; on the Vesdre; in a beautiful valley 10 miles by rail S. S. W. of Aix-la-Chapelle (see map of German Empire, ref. 5–C). It is well built and flourishing, and derives its prosperity chiefly from its manufactures of woolen goods (broadcloths and cassimeres). It has fourteen woolen-mills, dye-works, and manufactures of machinery. Down to the Peace of Luneville (1801) Eupen belonged to the duchy of Limburg, and consequently to the Austrian crown. Pop. (1890) 15,-445.

Euphemism [from Gr. εὐφημισμός, deriv. of εὔφημος, uttering words of good omen, abstaining from inauspicious words; εὖ, well + φάναι, speak]: a figure in rhetoric by which an unpleasant idea is expressed by indirect and milder terms. The euphemisms of the ancients generally originated in a desire to deprecate the ill-will of malevolent powers by attributing to them characteristics opposite to those which really belonged to them. Thus the Furies were by the Greeks termed Eumenides, "gracious."

Euphor′bia [named in honor of *Euphorbus*, physician to Juba, King of Mauritania]: a genus of plants of the family *Euphorbiaceæ*, or SPURGEWORTS (*q. v.*), having an acrid milky juice and monœcious flowers, included in a cup-shaped four to five lobed involucre resembling a calyx. More than 100 species of this genus are natives of the U. S. The seeds of "caper spurge" (*Euphorbia lathyris*) of Europe and the U. S. yield the fixed oil known as oil of euphorbia, a powerful cathartic. Some African euphorbias are large trees. Some species are quite cactus-like in appearance, and are popularly classed with them, e. g. *Euphorbia splendens*, a fleshy, prickly plant of the greenhouses; *Euphorbia meloformis*, from South Africa, closely resembles a melon cactus. *Euphorbia pilulifera* is a drug valuable in the treatment of asthma. See EUPHORBIUM.

Euphorbium: an acrid and inodorous gum-resin produced by the *Euphorbia officinarum* of Southern Africa and some other species, including *Euphorbia canariensis* of Western Africa, and *Euphorbia antiquarum* of the Levant. It is a violent emetic and purgative, and is sometimes used in the composition of plasters and in veterinary medicine.

Euphorion: a Greek poet and grammarian; b. at Chalcis in Eubœa; flourished about 250–220 B. C. He became librarian to Antiochus the Great, and produced epic poems and elegies besides several prose works, all of which have perished. He was learned to obscurity like Callimachus and Lycophron, and like these had his admirers and students, among them the Roman poet Gallus. Fragments of his writings may be found in Meineke's *Analecta Alexandrina*, p. 3.

Euphra′nor (in Gr. Εὐφράνωρ): Greek painter and sculptor; b. at Corinth: flourished about 350 B. C., a contemporary of Apelles. He excelled both in painting and in sculpture. Among his works, which are highly praised by Pliny and Plutarch, was a painting of Ulysses in his feigned insanity.

Eu′phrasy [from Gr. εὐφρασία, cheerfulness, deriv. of εὐφραίνεσθαι, to be happy; εὖ, well + φρήν, mind], or **Eyebright**: a plant of the family *Scrophulariaceæ*, the *Euphrasia officinalis*, a small annual herb from 2 to 8 inches high, a native of Asia, Europe, and North America. Milton in his *Paradise Lost* speaks of its virtues in clearing the eyesight. It is probably somewhat useful in inflammation of the eyes, from its astringent character. Some varieties are said to have in their blossoms a spot or "signature" resembling the eye, and this spot caused, or at least strengthened, the popular faith in its powers.

Euphra′tes (in Gr. Εὐφράτης; Turk. *El-Frat*): a large river of Western Asia, celebrated in all periods of history for the important events which have occurred on its banks and the magnificence of the cities whose walls it washed. It rises in Armenia, in the Anti-Taurus Mountains, by two branches—the Moorad and Kara-Soo—which unite near lat. 39° N. and lon. 39° E. The stream formed by this junction flows first southwestward, effects a passage through a defile of Mt. Taurus, and forms the boundary between ancient Syria and Mesopotamia. Near the town of Bir it approaches within 100 miles of the Mediterranean. After crossing the 36th parallel of N. latitude it pursues a general southeastern direction, flows through the extensive alluvial plains of Babylonia and Chaldæa, and enters the Persian Gulf at its northwestern extremity. Its total length, says Guyot, is 1,750 miles, and the area of its drainage is 255,000 sq. miles. It is with difficulty navigable down stream for about 700 miles above the site of Babylon, but many rapids impede up-stream boating. From Babylon to the sea, 450 miles, it is navigable. Its principal affluent, the Tigris, is nearly as large as the Euphrates itself. It receives no large tributary from the right hand. The width in some places is nearly 600 yards, but below Hillah its volume and width are reduced by numerous canals cut for irrigation. The name Shatt-el-Arab is given by the natives to that part of the river below the mouth of the Tigris. The melted snows of the mountains of the Taurus and Anti-Taurus cause a periodical inundation of the Euphrates in the spring. The water is highest in May and June. In ancient times the chief city on its banks was Babylon.

Euphros′yne [Gr. Εὐφροσύνη; εὖ, well + φρήν, mind]: one of the three Graces in Greek mythology; a personification of the genius of mirth or joy. See GRACES.

Eu′phuism [from Gr. εὐφυής, well-endowed; εὖ, well + φυή, natural growth]: an affected style of speaking and writing which became a fashion in the reign of Queen Elizabeth. The term originated in the title of a pedantic romance called *Euphues* (1580), written by John Lilly (Lyly) and abounding in antithesis, alliteration, and illustrations drawn from a fabulous natural history.

Euplexop′tera [Mod. Lat. from Gr. εὖ, well + Lat. *plexus*, a folding + Gr. πτερόν, wing]: an order of insects. See ENTOMOLOGY and FORFICULIDÆ.

Eu′polis (in Gr. Εὔπολις): Greek comic poet of the fifth century B. C.; in wit and grace second only to Aristophanes, if second even to him. A friend and collaborator of his great contemporary, he took part in the composition of the *Knights*, but the poets soon quarreled and accused each other of plagiarism. Alcibiades was one of the chief targets of his satire, and it was fabled that he took vengeance on the poet for his *Dunkards* [Gr. Βάπται] by drowning him. The origin of the story was doubtless the fact that Eupolis perished in a naval engagement 411 B. C., in consequence of which disaster the Athenians are said to have exempted poets from service. No less than seven of his pieces out of no more than seventeen received the first prize. The fragments may be found in Meineke's and Kock's collections.

B. L. GILDERSLEEVE.

Eurasia: the continent comprising Europe and Asia, which are themselves more usually termed continents.

Eura′sians [formed from *Europe* + *Asia*], or **Half-castes**: the offspring of European fathers and Asiatic mothers. The term is properly restricted to East India, where persons of this class are especially numerous in the large cities, as Calcutta, Madras, and Bombay. They generally receive a European education, but although they speak English grammatically they have a peculiarly disagreeable pronunciation. The girls are sometimes very beautiful, and often marry British officers; while the young men enter the Government offices or serve as clerks with merchants. They are very useful in this position, but as soon as they become rich, or advance to higher offices, they generally become insolent and wild. The Europeans, who also call them "Vepery Brahmins," do not hold them in high estimation. The natives call them "Cheechee."

Eure (Fr. pron. ēr): a department in the northern part of France; a part of the old province of Normandy. It is bounded N. by Seine-Inférieure, E. by Oise and Seine-et-Oise, S. by Eure-et-Loir, and W. by Orne and Calvados. Area, 2,301 sq. miles. It is intersected by the rivers Seine and Eure, and is bounded on the N. W. by the estuary of the former. The surface is mostly level; the soil is fertile. The staple productions are grain, hemp, flax, apples, and pears. Good horses, cattle, and sheep are reared here. Eure has important manufactures of cotton and woolen stuffs, paper, glass, stoneware, and copper-ware. Pop. (1896) 340,652. Capital, Evreux.

Eure-et-Loir (Fr. pron. ėr'ā-lwaar'): a department in the northwest part of France; bounded N. by Eure, E. by Seine-et-Oise and Loiret, S. by Loir-et-Cher, and W. by Sarthe and Orne. Area, 2,268 sq. miles. It is drained by the rivers Eure and Loir. The surface is partly level, and is in some parts diversified by hills and valleys. The soil is very fertile, and produces large crops of wheat. Good cavalry horses are raised here. This department is traversed by a railway connecting Paris with Chartres and Le Mans. Pop. (1896) 280,469. Capital, Chartres.

Eureka: city; capital of Humboldt co., Cal. (for location of county, see map of California, ref. 3–A); situated on Humboldt Bay, 7 miles from the ocean and 225 miles N. N. W. of San Francisco. It has excellent educational facilities, a $170,000 court-house, twenty-six lumber-mills, several tanneries, and a safe and commodious harbor on which improvements by means of jetties have been made by the Government. Eureka is one of the chief shipping-points for redwood lumber. Pop. (1880) 2,639; (1890) 4,858; (1900) 7,327.

Eureka: village and railway junction (incorporated in 1856); Woodford co., Ill. (for location of county, see map of Illinois, ref. 4–E); 19 miles E. of Peoria; in a fine agricultural district. It is the seat of Eureka College, connected with which is a normal school and a biblical school of the Disciples of Christ. The village also has an excellent high school and a very large manufactory of tile and pressed brick. Pop. (1880) 1,185; (1890) 1,481; (1900) 1,661.

EDITOR OF "JOURNAL."

Eureka: city and railway junction; capital of Greenwood co., Kan. (for location of county, see map of Kansas, ref. 7–I); 110 miles S. S. W. of Topeka. It has an academy, and is the trade center of an agricultural and stock-raising region. Pop. (1880) 1,127; (1890) 2,259; (1900) 2,091.

Eureka: town; capital of Eureka co., Nev. (for location of county, see map of Nevada, ref. 5–I); situated midway between Salt Lake and San Francisco, and 90 miles S. of the Southern Pacific Railway, with which the town is connected at Palisade by the Eureka and Palisade Railway. Eureka is the third town of importance in the State. The principal business is mining, and large quantities of lead and silver ore are produced. Pop. (1880) 4,207; (1890) 1,609; not returned separately in 1900.

Eureka: town; Juab co., Utah (for location of county, see map of Utah, ref. 5–L); on the Union Pacific and the Rio Grande Western railways; 66 miles S. of Salt Lake City. It is an important center for agriculture and mining. Pop. (1880) 122; (1890) 1,733; (1900) 3,085.

Eureka Springs: city (founded in 1879); capital of Carroll co., Ark. (for location of county, see map of Arkansas, ref. 1–B); situated 1,800 feet above sea-level in the Ozark Mountains and on Eureka Springs Railway; 8 miles S. of north line of the State, and 18 miles E. by S. of Seligman, Mo. It has seven churches and a summer normal school, and is chiefly noted for its medicinal springs and mild, bracing climate. The city has street railways and is lighted by gas; water-works in course of construction in 1893. Pop. (1880) 3,984; (1890) 3,706; (1900) 3,572.

EDITOR OF "TIMES-ECHO."

Eurhipidura, yu-rip-i-dyu'ra [Gr. εὖ, well + ῥιπίς (-ίδος), a fan + οὐρά, tail]: a term used by Gill to designate those birds having a small number of tail-vertebræ, the last of which are fused into a pygostyle, and having the tail feathers arranged in the shape of a fan. A few of the birds included in this group, like the ostrich and grebe, have no external tail, but this is due to degeneration. The group, or subclass, includes all existing birds and is opposed to *Saururæ*, fossil birds with a considerable number of long tail-vertebræ, having a pair of feathers attached to each vertebra. It is the equivalent of the *Ornithuræ* of Fürbinger.

F. A. LUCAS.

Euric: King of the West Goths; b. about 420, gained possession of the crown by killing his brother, Theodoric, 466. He consolidated the West Gothic empire in Gaul by subjugating the whole region between the Rhône, the Loire, the ocean, and the Pyrenees. He then sent Gotheric into Spain, and in a very short time the Romans were expelled and the whole peninsula was brought under the sway of the West Goths, with the exception of the small Suevic kingdom in Lusitania, which remained independent. The West Goths were Arians, and Euric is said to have persecuted the orthodox. D. at Arles, in 484.

Eurip'ides: one of the three great tragic poets of Greece; son of Mnesarchides and Cleito; according to tradition, b. on Salamis the night of the great battle, 480 B. C.; according to the Parian chronicle, four years later. A malicious story was current that his mother was an herb-seller, but certain it is that he received a careful education. In his boyhood he took part in religious festivals as a dancer and a torch-bearer. In his youth the future declaimer against athletes was himself an athlete. We read also of his essays in painting, but while yet a young man he devoted himself to dramatic art, and his first piece was acted in 455, receiving the third prize only. From this time on he worked steadily for the stage through evil report and good report. He was not only a tragic poet, but also a thinker and a scholar. He had a valuable library, of which he made diligent use, living as he did withdrawn from the world, and though he could not be called the disciple of a philosophical school, he was in close contact with the philosophic thought of his day, with such men as Anaxagoras, Protagoras, and Prodicus, and he could not have been a stranger to the Socratic circle. He was the apostle of enlightenment, and the faith in the gods that dominated Æschylus and sustained Sophocles gives way in Euripides to a rationalistic spirit, and when it returns it comes in a questionable shape. Unlike Æschylus, he did battle for no political cause; unlike Sophocles, he held no office, but he was for all that an ardent Athenian. Twice married, the infidelity of both his wives is said to have made him a woman-hater, but, rightly read, his tragedies show a profound appreciation of all the higher qualities of womanhood. He had three sons, one of whom, Euripides the younger, put on the stage the posthumous tragedies of his father. The close of his life was spent at the court of Archelaus of Macedon, the great patron of letters, and there he died in 406, torn in pieces by hounds, according to a doubtful tradition. Of ninety-two dramas or twenty-three tetralogies ascribed to Euripides, nineteen plays have been preserved, among them one satyr-drama, *Cyclops*, and one tragedy of doubtful genuineness, *Rhesus*. Several of the extant plays held high rank in antiquity, but of the remainder some are undoubtedly inferior to others that are lost, so that Euripides is not known exclusively by his best work. The chronological order of his plays is so hard to determine that Nauck has arranged them alphabetically—a safe plan. *Alcestis* (438), strictly speaking not a tragedy but a substitute for a satyr-drama, transcribed by Browning in *Balaustion's Adventure*; *Andromache*; *Bacchæ*, a posthumous play, considered a sort of poetical deathbed repentance (translated by Milman); *Cyclops*; *Electra*; *Hecuba*, once a great favorite of editors; *Helena*; *Heracleidæ*; *Hercules Furens* (translated by Browning in *Aristophanes's Apology*); *Hippolytus* (428), emulated by Racine in his *Phèdre*; *Ion*; *Iphigenia in Aulis*; *Iphigenia among the Taurians*, made additionally famous by Goethe's *Iphigenie*; *Medea* (431), which with the *Hippolytus* forms the double summit of Euripidean art; *Orestes*; *Phœnissæ*, a remarkable accumulation of tragic scenes; *Rhesus*; *Supplices*; *Troades*.

Euripides found less favor with the Athenian people than did Æschylus and Sophocles. He did not win his first victory until 441, and received the first prize only five times. After the beginning of the Peloponnesian war he seems to have struck the right vein, and to have become the favorite of Young Athens by virtue of his allusions to politics and his sympathy with the spirit of the times. The more popular he became with Young Athens the more virulently was he attacked by the comic poets, who were sworn foes of enlightenment and detested new-fangled notions of art. Even the grave did not hide Euripides from the persecution of Aristophanes, otherwise not an ungenerous enemy, and the *Frogs*, acted soon after the death of Euripides, is a formal indictment of the poet's art, as well as of the poet's moral teaching. But rhetoric and rationalism, point and pathos, won posterity for the poet of humanity, and "Euripides, the human, with his droppings of warm tears," ruled the stage from his death down to the present century, and while most scholars nowadays see in him a departure from the Hellenic standard, which from the Hellenic point of view must be called a decline, all recognize the greatness of the genius who opened to the world a new realm of dramatic art. His language may lack the large utterance of Æschylus, and the variety of its tones may produce an inharmonious effect. His meters and rhythm may mark a departure from the high standard of a severer art and display too much laxness here, too much mechanical uniformity there; and his sensational monodies and trivial melodies may deserve all the censure so freely dealt out by critics ancient and modern. His plots may lack the subtle articulation that makes the plays of Sophocles as inevitable as is life itself; the choruses, exquisitely beautiful sometimes in themselves, may show too plainly that they are adornments and not instruments of the drama; the dialogue may degenerate into dialectic digladiation; there may be too much moralizing and too much paradox; but Euripides is a great poet, not merely a great preacher; and both as poet and preacher he still retains his hold on those whose judgment is not swayed by critical cant. Editions of separate plays are too numerous to mention. Important editions of the text have been put forth by Kirchhoff (1855), and by Nauck in the Teubner series, an edition with notes in English by F. A. Paley. There are valuable selections, with notes, by Wecklein and by Weil. Especially noteworthy are von Wilamowitz-Möllendorff's various contributions to Euripidean study. See the introduction to his *Herakles* (1889). Of English renderings, Potter's translation in verse is out of date. A new translation in prose by E. P. Coleridge is in progress (1893). Fitzgerald's *Hippolytus* and Webster's *Medea* may be added to the translations incidentally mentioned above. See also W. C. Lawton, *Three Dramas of Euripides* (Boston, 1889).

B. L. Gildersleeve.

Euroc'lydon [Gr. εὐροκλύδων, corrupt reading Acts xxvii. 14 for εὐρακύλων = Lat. *euraquilo*, northeast wind]: a violent wind of the Mediterranean mentioned in Acts xxvii. 14. The Vulgate renders it *euro-aquilo*, i. e. northeast wind. But in some of the best manuscripts (Sinaitic, Vatican, and Alexandrian) εὐρακύλων, east northeast wind, is the reading, instead of εὐροκλύδων, northeast wind; and this reading is adopted by the best recent editors. The wind in question is said to be half a point N. of E. N. E. See Smith's *Voyage and Shipwreck of St. Paul* (1856; 3d ed. 1866).

Euro'pa (Gr. Εὐρώπη): in classic mythology, a daughter of Agenor, King of Phœnicia, and a sister of Cadmus. According to a poetic legend, Jupiter, in the form of a bull, carried her on his back to Crete, where he assumed human form and won her love. She bore by him Minos, Sarpedon, and Rhadamanthus.

Europe, yu'rup [Lat. *Euro'pa*, so named by the Asiatic Greeks, either from its wide coast or from the Phœnician Princess Europa]: one of the four great continents, and historically the most notable; occupies an area of about 3,781,647 sq. miles; bounded N. by the Arctic Ocean, E. by Asia, S. E. by the Caspian, S. by Asia, the Black Sea, and the Mediterranean, and W. by the Atlantic. The boundaries are well defined except on the E. and S. E., where the Ural and Caucasus Mountains do not exactly coincide with the frontiers of European and Asiatic Russia; Caucasia especially is variously classified and mapped as in Europe or Asia. Its greatest breadth is about 3,400 miles, and its extent from N. to S. 2,400 miles at the extreme points. Its territory has been more carefully mapped out than any other part of the earth's surface. Great Britain and Ireland, although distinct islands, always rank as a part of Europe, having been separated from the continent at no very remote period. In the N., Iceland and Nova Zembla, and in the Mediterranean, Corsica, Sardinia, Sicily, Malta, Crete, the Ionian and the Balearic islands also belong to Europe. Europe is only about one-quarter as large as either Asia or America, and is more populous in proportion to area than any other continent, having about a hundred inhabitants to the square mile. The length of coast-line is about 20,000 miles, 8,000 of this being on the Atlantic, 3,600 on the Arctic Ocean, and 7,800 on the Mediterranean and Black Seas, giving unequaled advantages for commerce. Its three great southern peninsulas—Italy, the Græco-Balkan Peninsula, and the Iberian Peninsula of Spain and Portugal—form very marked features of its topography.

Geology.—The great Mediterranean basin is the geological feature of Southern Europe, having its north limit at the chains of mountains known as the Cévennes, the Jura, etc. The prevailing rocks are plutonic and metamorphic, of which the Alps are composed, and which are found in France, Germany, Scandinavia, etc. In Spain the Silurian rocks are found. Other Palæozoic rocks—the Devonian, Carboniferous, and Permian—occupy large areas in Russia, the British islands, etc. Germany, France, and England have extensive strata of the Secondary formations, and the Tertiary are still more widely distributed. Cretaceous rocks abound in Denmark, Greece, and Southern Russia, besides forming a large part of the Paris basin and the basin of the lower Rhine. Mineral wealth abounds. Mines of iron ore, lead, copper, coal, and salt are extensively worked, while for gold and silver Europe is mainly dependent on other countries. Europe abounds in mineral springs of great variety and chemical virtue.

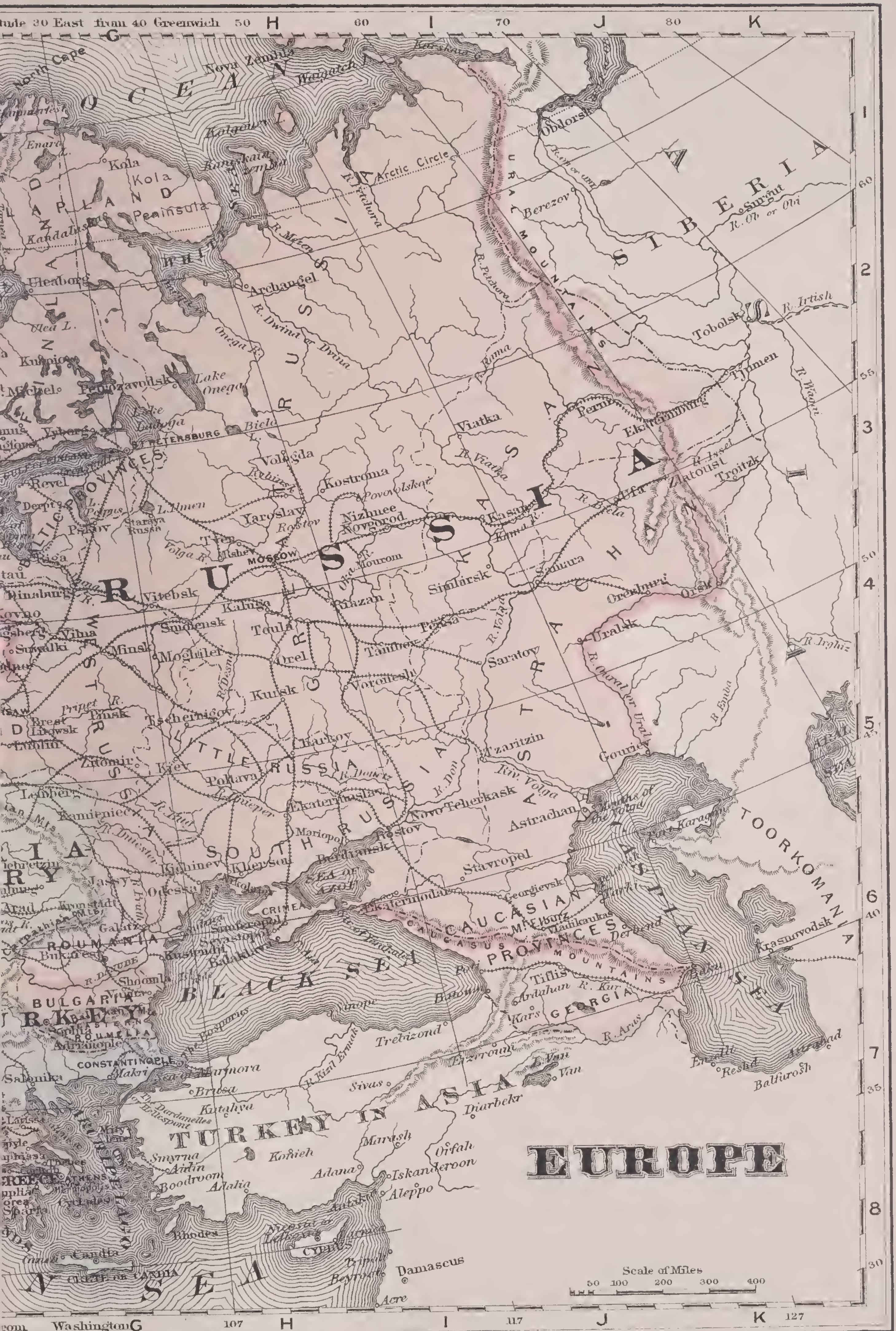
Mountains and Plains.—The leading physical features are the mountainous region in the S. and the low district in the N. and E. The central mountain system is the Alps, which extend in a great arc of about 700 miles along the frontiers of Italy and France, through Switzerland and western portions of the Austrian empire, and along the border of Southern Germany. They culminate in Mont Blanc, 15,779 feet in height, the highest point in Europe (if we exclude the Caucasus), but inferior to the chief summits of Asia, Africa, North and South America. N. and E. of the Alps are the Jura, Vosges, Black Forest, Sudetic Mountains, Carpathians, and other ranges of Central Europe. Westward the Cévennes and other mountains of Southern France form connecting links between the central highland region and the Pyrenees. This latter range extends in an almost uniform wall along the border of France and Spain, and reaches a height of over 11,000 feet. All of the southern peninsulas are in general mountainous or elevated. The Græco-Balkan Peninsula has the Balkans, Pindus, and various groups of Greece; Italy is traversed by the Apennines, whose principal peak is over 9,000 feet high; and Spain is a table-land crossed by chains whose southernmost, the Sierra Nevada, has about the elevation of the Pyrenees. The lowlands comprise considerable portions of Western and Northern France, Belgium, Netherlands, Denmark, Northern Germany, Galicia, and Russia. Scandinavia is traversed by mountains, while the British islands are undulating, hilly, and in places mountainous.

Rivers.—The principal rivers are the Danube, Volga, Ural, Dnieper, Don, Neva, Petchora, the two Dwinas, Niemen, Oder, Rhine, Elbe, Vistula, Tagus, Duero, Ebro, Guadalquivir, Loire, Garonne, Rhône, Seine, Thames, Severn, Humber, Po, etc. The Volga drains 500,000 sq. miles of Russian territory, and the Danube has a basin estimated at 300,000 sq. miles. The flow of some of these is very irregular, and the Danube, the Elbe, the Loire, and others are subject to serious floods. Extensive engineering works to promote navigation and diminish the dangers of floods have been executed. The rivers penetrate the whole continent, fertilizing the soil and rendering great natural facilities to commerce. No European river has a great waterfall. The famous Staubbach fall is a mere rill, although the whole descent is about 1,000 feet.

Lakes.—Europe abounds in lakes, Lake Ladoga in Russia being the largest. Minor lakes, celebrated for their beauty, are found in the mountainous regions, as Lakes Geneva, Maggiore, Garda, Como, Neufchâtel, Constance, Zurich, Lucerne, etc.

Climate.—The numerous small lakes of Europe increase the area of evaporation, and tend to make the climate far more moist than that of America or Asia. This is further increased by the Mediterranean, and the large water surface penetrating and hemming in the continent has a powerful tendency to ameliorate the climate; and this tendency is greatly strengthened by the proximity of the Gulf Stream to the western coast of Europe. The temperature of any given parallel of latitude in the greater part of Europe is several degrees warmer than the regions of the same latitude in America. Russia, however, has a continental climate. The whole of Europe belongs to the north temperate zone, except the small portion extending into the north frigid zone. While no part of the continent touches the tropics, the south portion is marked by the dryness of the summer peculiar to the sub-tropical zone. The rainfall occurs most largely in the winter in Southern Italy and Spain; autumn and spring are the rainy seasons in Northern Spain

Long. 20 West
Longitude East
GREENLAND
Jan Mayen I.
ICELAND
Reikiavik
Eskifiorth
Arctic Circle
ARCTIC
ATLANTIC OCEAN
Faroe Is.
Shetland Is.
Orkney Is.
Rokol Bank
BRITISH ISLES
Aberdeen
Londonderry
Dublin
Limerick
Galway
Valentia
C. Clear
Milford Haven
London
Atlantic Telegraph Cable
French Telegraph Cable
NORTH SEA or GERMAN OCEAN
Christiansund
Trondhjem
Romsdal
Bergen
CHRISTIANIA
Stavanger
Christiansand
Hernosand
Gefle
Upsala
STOCKHOLM
Gottenburg
Halmstad
DENMARK
COPENHAGEN
Bodoe
Umea
Wisby
HANOVER
BERLIN
Stettin
Posen
Dantzic
DRESDEN
GERMAN EMPIRE
PRUSSIA
BAVARIA
MUNICH
VIENNA
BUDAPEST
AUSTRIA HUNGARY
Breslau
BRUSSELS
BELGIUM
THE HAGUE
Amsterdam
PARIS
Versailles
Orleans
Nantes
Tours
Troyes
Dijon
Besançon
Poitiers
Limoges
Angouleme
Rochelle
Bordeaux
Montauban
Toulouse
Avignon
Marseilles
Grenoble
Lyons
FRANCE
BERNE
SWITZERLAND
Geneva
Milan
Turin
Genoa
Leghorn
Florence
Bologna
Ravenna
Venice
Trieste
ROME
Teramo
Naples
Bari
Taranto
Palermo
Messina
Reggio
Syracuse
Caltanissetta
Malta
Corsica
Ajaccio
SARDINIA
Sassari
Cagliari
BAY OF BISCAY
Bayonne
Cantabrian Mts.
Leon
Valladolid
Sierra Guadarrama
MADRID
SPAIN
Toledo
Sierra Morena
Seville
Cadiz
Granada
Malaga
Cartagena
Murcia
Valencia
Barcelona
Andorra
PYRENEES MTS.
Gibraltar
Tangier
Tetuan
PORTUGAL
LISBON
Tagus
Oporto
BALEARIC IS.
Majorca
Minorca
MEDITERRANEAN
Oran
ALGIERS
Philippeville
Bonah
Constantina
TUNIS
Fez
MOROCCO
AFRICA
Mogador
Lipari Is.
IONIAN SEA
ADRIATIC SEA
Belgrade
Spalatro
HERZEGOVINA
MONTENEGRO
Dulcigno



EUROPE
R U S S I A
S I B E R I A
TOORKOMANIA
TURKEY IN ASIA
BLACK SEA
CASPIAN SEA
SEA OF AZOF
CAUCASIAN PROVINCES
CAUCASUS MTS.
URAL MOUNTAINS
LITTLE RUSSIA
SOUTH RUSSIA
WEST RUSSIA
GREAT RUSSIA
ROUMANIA
BULGARIA
GREECE
CRIMEA
GEORGIA
Arctic Circle
Nova Zembla
Waigatch I.
Kolguev I.
Kola Peninsula
Archangel
St. Petersburg
Moscow
Volagda
Kostroma
Yaroslav
Nizhnee Novgorod
Kasan
Viatka
Perm
Ekaterinburg
Tobolsk
Tjumen
Obdorsk
Berezov
Surgut
Zlatoust
Troitzk
Ufa
Samara
Simbirsk
Saratov
Orenburg
Orsk
Uralsk
Tzaritzin
Astrachan
Gouriev
Penza
Tambov
Riazan
Voronesh
Kursk
Orel
Toula
Kaluga
Smolensk
Vitebsk
Minsk
Mogholev
Tschernigov
Kiev
Poltava
Charkov
Ekaterinoslav
Novo Tcherkask
Rostov
Stavropol
Georgievsk
Ekaterinodar
Odessa
Kishinev
Kherson
Nikolaev
Simferopol
Sevastopol
Tiflis
Derbend
Baku
Kars
Batoum
Trebizond
Erzroum
Sinope
Sivas
Diarbekr
Van
Smyrna
Konieh
Adana
Iskanderoon
Aleppo
Damascus
Beyrout
Tripoli
Acre
Rhodes
Cyprus
Brusa
Constantinople
Salonika
Athens
Sparta
Krasnovodsk
Resht
Balfurosh
Astrabad
R. Volga
R. Don
R. Dnieper
R. Ural
R. Irtish
R. Ob or Obi
R. Petchora
R. Dwina or Dvina
Lake Ladoga
Lake Onega
Scale of Miles
50 100 200 300 400
Longitude 30 East from 40 Greenwich 50 H 60 I 70 J 80 K
from Washington G 107 H I 117 J K 127

and Italy and in Southern France. Summer brings a rainy season to Switzerland, Germany, Austria, Prussia, and Sweden. The British islands have their maximum rainfall in winter. Meteorological statistics show the maximum rainfall at Skye and in the West of England, with 101 to 189 inches of annual rainfall, while that of Salamanca in Spain is only 9 inches, and the average in Sweden and Russia and parts of Germany is as low as 15 to 21 inches per annum. Western Europe has heavier rains than Eastern, and the most prevalent wind is the southwest. In Southeastern Europe the prevailing winds are from the N. and E., the latter in fall and winter. The snow-line in the mountains varies from 8,000 to 10,000 feet above the sea among the Alps, while in Norway the snow-line comes down to the altitude of 2,360 feet.

Soil and Productions.—The climate of Europe has such variety as to favor the growth of the richest products of the vegetable kingdom. The regions of the Mediterranean, where ages of fertility have produced both vernal and autumnal growths, and the south of Spain, where almost tropical luxuriance bears fruits every month, contrast strongly with the Arctic regions with their short period of vegetation. Of the cereal crops wheat is heavily grown in Russia, Austria, France, England, Germany, and the countries of the Danube. Barley is an almost universal crop, as are rye and oats in Central and Northern Europe. Maize or Indian corn is largely cultivated in the south; the potato has spread over Central and Northern Europe. Beans, pease, clover, lucerne, sainfoin, hemp, flax, etc., are grown profusely. The cultivation of the vine is of prodigious extent (being profitably grown as far north as 50°), and forms a vast industry in France, Italy, Austria, and Spain. The olive flourishes in Italy, Greece, Spain, and Portugal, growing two crops annually. Tobacco is grown all the way from Sicily north to Sweden. The beet is cultivated in Central Europe for the manufacture of sugar. Among fruits and nuts there are the orange, fig, almond, citron, pomegranate, pistachio, apples, pears, cherries, plums, and date-palms. The timber trees, though greatly depleted by centuries of consumption, still furnish forest products for fuel and the arts. Northern Europe has a large timber trade. Among the trees are the oak, chestnut, beech, ash, alder, birch, pine, elm, maple, poplar, hemlock, and fir.

Zoölogy.—According to Wallace, Europe belongs to the palæarctic region. While wild animals are by no means so numerous as on other continents, the domestic animals are reared in large numbers and in great perfection. The larger varieties of Carnivora are few. Among the characteristic animals are the reindeer, bear, wolf, fox, weasel, badger, hedgehog, chamois, hare, rabbit, squirrel, marten, etc. The birds number 247 genera and 531 species, but of these only two or three are peculiar to this continent. There are the thrush, warbler, magpie, jackdaw, linnet, sparrow, shrike, kingfisher, vulture, quail, eagle, hawk, kite, buzzard, owl, swallow, lark, nightingale, blackbird, etc. The waters, both coastwise and inland, are well stocked with fish, among which the salmon holds a chief place, while the herring, cod, sardine, sprat, perch, tunny, anchovy, etc., abound. Oysters are found all along the Atlantic coast, and their artificial culture is widely extending, though in quality they are inferior to the American oyster. The sponge and the coral fisheries are actively pursued on the Mediterranean. Among reptiles the tortoise, turtle, chameleon, lizard, adder, viper, frog, and toad are the principal. Insects are not so numerous nor so annoying in Europe as in the warmer regions of the globe.

Population.—The inhabitants of Europe embrace many composite races, the characteristics of which have been greatly changed and modified in successive ages by migrations, intermarriages, and conquests. Modern archæologists have found evidence of human inhabitants in Europe as early as the Pleistocene period. Remains of these races, called the men of the Old Stone Age (and distinguished by some as the cave-dwellers and the inhabitants of the river-beds), are found in England, Belgium, France, Germany, and Switzerland. At a later but still prehistoric period came the Neolithic people, still of the Stone Age. The great Aryan race, still predominant in Europe, came in at an uncertain period, probably by way of Asia Minor. Writers on ethnology mark out four great Aryan detachments—viz., the Græco-Latin or southern, the Celtic or central, the Teutonic or northern, and the Slavonic or northeastern. Of the Semitic race (mainly Jews), the migration into Europe was gradual. Brachelli estimated the 287,000,000 Europeans of Aryan origin to be composed approximately as follows: German peoples (including Germans, Dutch, Flemings, British, Swedes, Norwegians, and Danes), 95,000,000; Græco-Latin peoples (including French, Italians, Spaniards, Portuguese, Greeks, Ladins, Moldavians, Wallachians, etc.), 96,400,000; Slavonic peoples (including Russians, Poles, Bohemians, Moravians, Wends, Croatians, Servians, Bosniaks, Bulgarians, Slavonians, etc.), 82,170,000; Celts, 4,100,000; Semitic peoples, 3,200,000; Lithuanians, 2,800,000; Albanians, 1,300,000; Basques, 700,000; Gipsies, 600,000; Circassians, 400,000; Armenians, 260,000. There were besides this overwhelming preponderance of Aryanized populations only about 4,000,000 Mongolians (Tartars, Turks, and Kalmucks) and 10,500,000 of Uralian peoples (Magyars and Finns). The increase in population since his estimate is most noteworthy among the Germans and Russians.

Language.—There are about sixty distinct languages now spoken in Europe; most of these are of the Aryan family, including the Hellenic, Italic, Celtic, Teutonic, Slavonic, and Lettish branches. The Semitic branch includes the Hebrew, Arabic, etc., and the Tartaric, the Turkish, Magyar, Lapponic, and many other dialects of limited area. Rapid changes are going on which appear destined to extinguish ultimately many of the minor languages in favor of those great vehicles of speech, the English, French, German, Italian, Spanish, and Russian.

Political Divisions.—Recent changes in the political map of Europe have left its principal divisions as follows: 4 empires, 12 kingdoms, 4 republics, 4 principalities, and 1 grand duchy. The areas and populations of these political divisions are as follows:

COUNTRIES.	Government.	Sq. miles.	Population.
Andorra	Republic	175	6,000
Austria-Hungary	Empire	240,942	41,358,886
Belgium	Kingdom	11,373	6,495,886
Bulgaria	Principality	37,860	3,154,375
Denmark	Kingdom	15,289	2,185,335
France	Republic	204,092	38,517,975
Germany	Empire	208.670	52,279,901
Great Britain and Ireland	Kingdom	120,849	37,879,285
Greece	Kingdom	25,014	2,433,806
Italy	Kingdom	110,623	30,535,848
Lichtenstein	Principality	70	9,593
Luxemburg	Grand Duchy	998	211,088
Monaco	Principality	8	13,304
Montenegro	Principality	3,630	220,000
Netherlands	Kingdom	12,656	4,669,576
Norway	Kingdom	124,445	2,000,917
Portugal	Kingdom	34,038	5,082,247
Roumania	Kingdom	48,307	5,500,000
Russia	Empire	2,081,025	106,114,589
San Marino	Republic	32	8,200
Servia	Kingdom	19,050	2,256,084
Spain	Kingdom	197,670	17,565,632
Sweden	Kingdom	172,876	4,919,260
Switzerland	Republic	15,976	2,296,848
Turkey	Empire	61,200	4,780,000
Bosnia, Herzegovina, and Novibazar, occupied by Austria-Hungary.	Belong to Turkey.	23,570	1,504,091
Totals		3,770,438	371,999,726

The increase of population in Europe is very slow, being probably less than 1 per cent. per annum. War and emigration are the principal causes retarding its growth. The areas of densest population are near London, Paris, Milan, Naples, and Leipzig. The keeping on foot of great armies and the maintenance of costly navies constitute one of the chronic checks to the prosperity of Europe. In productions Europe (as has been estimated) raises annually less food than its population consumes, and for clothing it is dependent upon other countries for all its cotton and for much of its wool and silk, the raw materials. Europe, however, more than makes up by its labor and skill for all it lacks in materials; its industries are so vast that it may be called one great workshop, supplying with its manufactures not only its own wants, but a large share of the wants of other divisions of the world. See Europe in the Appendix.

Education.—The condition of Europe exhibits a great advance in education during the nineteenth century. In every country (even including Turkey) laws exist for maintaining primary schools, and education is compulsory in almost all the nations (Russia, Turkey, Belgium, and the Netherlands are the chief exceptions); but in Italy, Spain, and others of the southern countries the compulsory law is not strictly enforced. Switzerland and Prussia hold the highest rank in the universal diffusion of education.

Religion.—Paganism has but little foothold in Europe, which is pre-eminently Christian. There are three grand divisions—the Roman Catholic Church, the Greek or Eastern Church, and the Protestant Church. Roman Catholicism has much the largest number of adherents, especially in Austria, France, Italy, Belgium, Spain, and Portugal. A comparison of the adherents of the leading religions, compiled from the latest data, gives in round numbers:

COUNTRIES.	Roman Catholics.	Protestants.	Greek Orthodox.	Jews.
Great Britain and Ireland.	5,200,000	27,400,000	....	100,000
Germany	17,600,000	31,000,000	....	500,000
France....................	30,000,000	700,000	....	50,000
Italy.....................	30,000,000	60,000	....	....
Austria-Hungary...........	27,000,000	3,600,000	4,500,000	1,700,000
Russia....................	14,000,000	5,000,000	70,000,000	4,000,000
Spain.....................	17,000,000	....	....	....
Portugal..................	4,300,000	....	....	....
Switzerlaud...............	1,200,000	1,700,000	....	....
Belgium	6,100,000	....	....	....
Netherlands	1,600,000	2,700,000	....	100,000
Denmark	....	2,100,000	....	....
Sweden....................	....	4,500,000	....	....
Norway....................	....	2,000,000	....	....
Roumania	100,000	....	4,500,000	300,000
Servia	....	....	2,000,000	....
Bulgaria..................	....	....	2,500,000	....
Greece....................	....	....	2,100,000	....
Totals, about	154,100,000	80,760,000	85,600,000	6,750,000

There are several millions of Mohammedans, mostly in Turkey, Russia, and Bulgaria. There are also several millions in Austria-Hungary belonging to the Greek-Oriental Church, and in France about 7,000,000 who refuse to make a statement of religious belief.

History.—The authentic annals of Europe commence with the Greeks. Greece founded colonies, but her people were not given to conquest, while the history of Rome, which soon supplanted Greece as a political power, is one of continued aggression and territorial acquisition. Before the Christian era Rome had successively conquered Sicily, Spain, Greece, and Gaul. In the time of Augustus the Roman rule covered the whole region now embracing France, Belgium, Spain, Portugal, Western Germany, Switzerland, Italy, much of the Austrian empire, Servia, Turkey, and Greece. When Constantine established the seat of government at Byzantium (now Constantinople) and made Christianity the religion of his empire, his territorial outlines were nearly the same, with the addition of Britain. The prominent facts of the third and following centuries are the migrations of the peoples, Huns, Teutonic races, and others, their assaults on the empire, and the empire's internal decay, with the spread of Christianity. In A. D. 395 came the division of this great empire into Eastern and Western, the latter embracing much the larger territory and population. The Western Empire, which formally ended in 476, was temporarily revived by Charlemagne in 800; the idea of a world-empire was seen in the Holy Roman Empire of the German nation, established in the tenth century, important through mediæval times, and lingering with power and prestige greatly diminished down to 1806. Gradually the German race became ascendant. Angle, Saxon, and Jutish kingdoms were established in England; a West Gothic kingdom was founded in Spain; the Franks and Burgundians formed monarchies in France and Central Europe; the East Goths, and after them the Lombards, ruled in Italy. Somewhat later came the great Slavic influx into Southeastern and Eastern Europe. The Saracens appeared in the south, and held a great part of Spain for several centuries.

Numerous conquests and changes mark the map of the Middle Ages. The great institutions of feudalism and chivalry are developed. The papal power of Rome becomes dominant in the politics of many nations, and the Eastern and Western Churches are separated. France and England struggle for possessions on the Continent; Western and Central Europe sends forth a crusade for the recovery of Christ's sepulcher, and the advance of the Ottoman power ends in the overthrow of the Eastern empire by the Turks in 1453. The close of the Middle Ages is signalized by the revival of learning and art known as the Renaissance, and by the development of parliamentary institutions in England. In the fifteenth century a tendency toward absolutism and centralization exists, together with a spirit of discovery and exploration; the new trade routes lead to the decline of such powers as the Hanse cities, Venice, etc., and the rise of Spain and Portugal. The sixteenth century is marked by the Reformation, and by the vast extension of the empire of Charles V. over the Netherlands, Spain, Naples, and the German states, leading to wars and rivalries which lasted for generations. The religious wars in France between the Catholics and Huguenots resulted in the final triumph of the former, while Germany was desolated by the politico-religious Thirty Years' war of 1618–48. In the seventeenth century a prolonged struggle in England ended in favor of constitutional government; the same period on the Continent saw Spain displaced by France as the great military power. In the eighteenth century Russia and Prussia rise to the rank of great powers, and Sweden sinks from that position; England and France carry on a rivalry for expansion; Poland disappears from the map, and Turkey ceases to be threatening. The century closes with the great crash of the French Revolution.

From 1789–1815 war again broke up the political frontiers through nearly all Europe, ending in a temporary triumph of absolute government, followed by many more or less successful revolutions, which gave constitutional or representative government to most of the nations. A revolutionary wave in 1830 caused various changes; Belgium became a separate constitutional kingdom, France placed Louis Philippe, a constitutional king, on the throne, and about this time the independence of Greece was secured. In 1848 a revolutionary storm swept over Europe; Rome expelled the pope, and Sicily the Bourbons; France became temporarily a republic, and the King of Prussia was forced to grant a constitution and a representative government to the people. A reaction set in, however, which carried back the tide of political reform. In 1854–56 the Crimean war was fought, Great Britain, France, and Sardinia maintaining the integrity of Turkey against Russia. Great changes soon followed in Italy, whose chief separate states consolidated under one constitutional king in 1861, though the complete unity of Italy was not effected until 1870. Germany and Austria wrested Schleswig-Holstein from Denmark in 1864, and in 1866 the jealousies of Prussia and Austria led to the victory of the former and the establishment of the North German Confederation; 1870 saw the great Franco-Prussian war, which lasted less than a year, ending in the firm establishment of the French republic and the crowning of the Prussian king as emperor of the new German empire. In 1877 Russia declared war against Turkey, and but for the intervention of Great Britain and other powers would have swept her from the rank of a European nation. Turkey has recognized the independence of Roumania and Servia, now kingdoms, while the principality of Bulgaria, lately increased by Eastern Roumelia, is practically independent. In the early part of 1897 the Christian population of Crete declared in favor of annexation to Greece, and a Greek army was landed at the request of the insurgents. The great powers, however, intervened and blockaded the Cretan coasts. Autonomy was promised, but this did not satisfy either the Cretans or the Greeks. In the war which ensued, Greece was beaten by the Turks at almost every point, and instead of winning Crete, lost a few small areas along her northern frontier.

Of the six great powers of Europe, Germany, Austria-Hungary, Italy, France, Russia, and Great Britain, the first three form the Triple Alliance which profoundly influences Continental politics; opposed to this league is the looser bond of union between France and Russia.

To maintain what is called the "balance of power" in Europe has cost a long succession of bloody wars, a sacrifice of countless lives, and a squandering of vast treasure. There is a tendency to adopt arbitration instead of war, and the present so-called "concert" of the great powers professes to have for its object the maintenance of the peace of Europe.

Revised by EDMUND KIMBALL ALDEN.

Euryd'ice (in Gr. Εὐρυδίκη): the wife of ORPHEUS (*q. v.*). She died in consequence of the sting of a serpent, and, according to the poetic legend, Orpheus descended to the infernal regions, and persuaded Pluto to restore her to him on condition that she should walk behind Orpheus, and that he should not look back until they had reached the upper world. But he was tempted to look back, and finally lost her. (See Vergil's *Georgics*, book iv., 454.) There are seven other mythical persons bearing the name Eurydice, but the wife of Orpheus is the most celebrated of them.

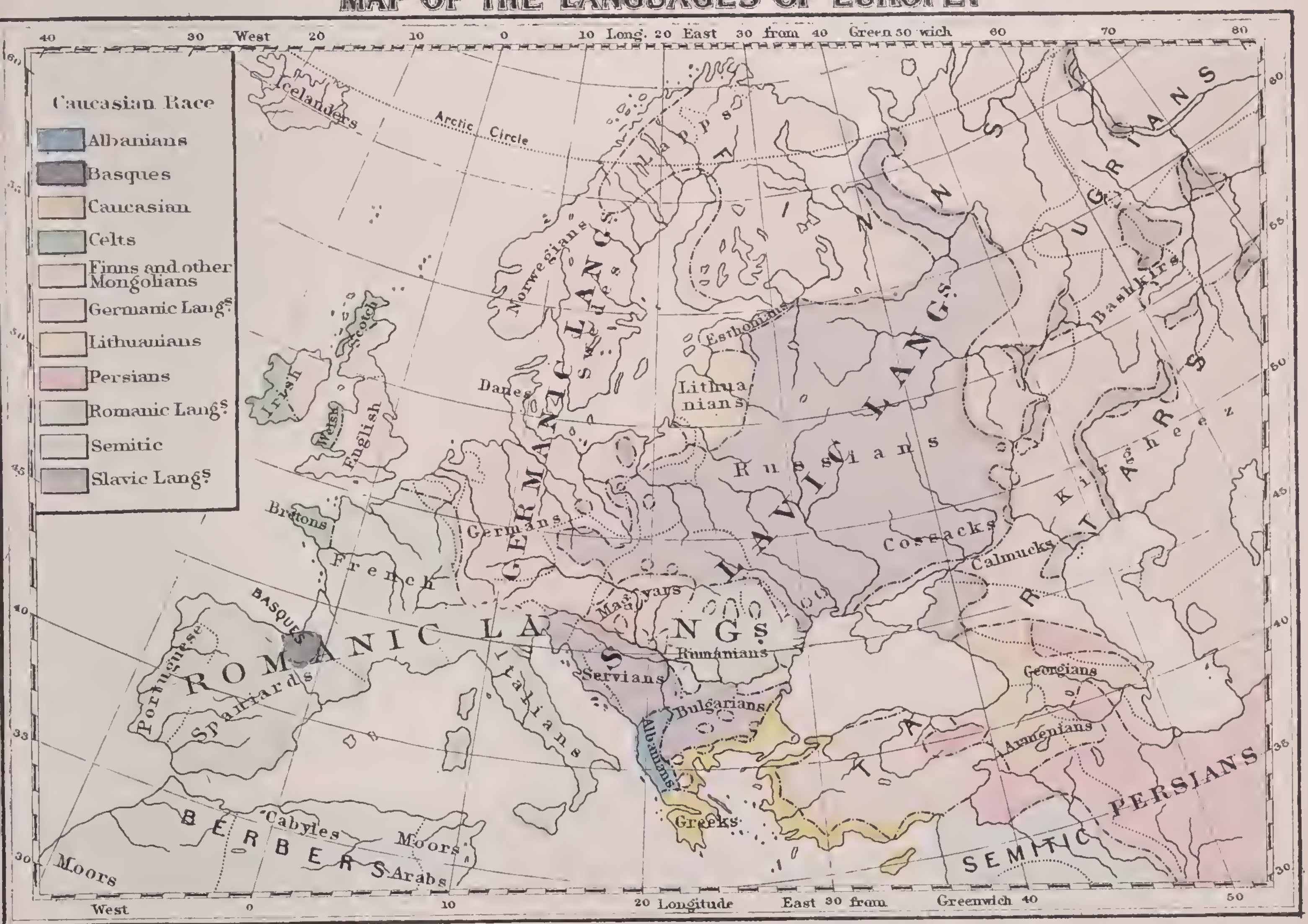
Euryp'terus [from Gr. εὐρύς, broad + πτερόν, wing]: a genus of Arthropods occurring fossil in Silurian and Devonian rocks, which bears resemblances to both scorpions and *Limulus*. It has a square cephalothorax bearing five pairs of feet (one of which terminates in a large pincer), and a

EUROPE UNDER THE ROMANS (2nd CENTURY).

EUROPE UNDER THE CARLOVINGIANS (9th CENTURY).

EUROPE UNDER NAPOLEON I. (1810-1812).

MAP OF THE LANGUAGES OF EUROPE.



long tapering abdomen (twelve-jointed) terminating in a spine like that of the horseshoe crab. It belongs to the *Merostomata.* J. S. K.

Euse'bius Pam'phili: Bishop of Cæsarea, theologian and writer of ecclesiastical history; b. in Palestine about 260 A. D. He assumed the surname PAMPHILI in honor of his friend Pamphilus the martyr. He became Bishop of Cæsarea in 314 or 315 A. D., and took a prominent part in the Council of Nice (325 A. D.). The Emperor Constantine the Great, who was his friend, selected him to open this council by an oration. Eusebius was inclined to moderation and peace, used his influence to reinstate Arius, and was a leader of the Semi-Arians. He was one of the bishops who censured Athanasius at the Council of Tyre (334). He was very eminent for learning, as well as for talents. He wrote in Greek, besides several works that are lost, an *Ecclesiastical History from the Christian Era to 324 A. D.*, which is of the greatest value; a *Life of Constantine the Great*; *Gospel Preparation* (*Præparatio Evangelica*); a *Universal History or Chronicle*; and a work *On the Proof or Demonstration of the Gospel* (*De Demonstratione Evangelica*). D. about 340 A. D. Complete editions of his works have been published by Migne in his *Patrologia Græca* (XIX.–XXIV., 6 vols., 1856–57), and by Dindorf (1865, *seq.*). A new critical edition of his historical works has been published by F. A. Heinichen (3 vols., Leipzig, 1868–70). Eng. trans. of the *History* by A. C. McGiffert, with elaborate notes, and of the *Life of Constantine the Great, Constantine's Oration to the Assembly of the Saints,* and *Oration in Praise of Constantine*, by E. C. Richardson (New York, 1890). There is a partial English translation of his *Præparatio* by H. Street, *Leaves from Eusebius* (London, 1842); a complete translation of his *History of the Martyrs in Palestine* by W. Cureton (London, 1861); of his *Theophania* by S. Lees (Cambridge, 1843). See the *Life of Eusebius* by Stein (Würzburg, 1859), and by V. Hély (Paris, 1877).
Revised by S. M. JACKSON.

Eusta'chian Tube [named after its discoverer, Bartolomeo Eustachi, an Italian anatomist (d. 1574)]: in anatomy, the canal leading from the middle ear to the pharynx. It is developed from the first (spiracular) gill cleft of the embryo; and in the amphibia, reptiles, birds, and mammals it enters into close connection with the auditory organ proper. Its function is to equalize the pressure of the air on either side of the tympanic membrane, and when it becomes closed by disease the hearing is impaired. J. S. K.

Eusta'thius (in Gr. Εὐστάθιος): Greek scholar; Archbishop of Thessalonica from 1175 A. D.; author of a wordy commentary on the *Iliad* and *Odyssey*, which is still consulted, though it has lost much of its consideration since the discovery of the Homeric scholia. It was reprinted from the original Roman ed. by Weigel (1825, *sqq.*). B. L. G.

Eustis, HENRY LAWRENCE: U. S. army officer and engineer; b. at Fort Independence, Boston, Mass., Feb. 1, 1819; studied at Harvard, and graduated at West Point in 1842; served as lieutenant of engineers in the construction of fortifications, etc., and assistant professor at the Military Academy till he resigned (Nov. 30, 1849) to become Professor of Engineering in Lawrence Scientific School of Harvard University. In the civil war he was colonel of the Tenth Massachusetts Volunteers, serving at Williamsport, Fredericksburg, Marye's Heights, Salem, Gettysburg, Rappahannock Station, Mine Run, Wilderness, Spottsylvania, Cold Harbor, and many minor actions; and became brigadier-general of volunteers in 1863, but resigned June 27, 1864, to resume his professorship at Cambridge, Mass. D. Jan. 11, 1885.

Eustis, JAMES BIDDLE: See the Appendix.

Eustis, WILLIAM, LL. D.: physician; b. in Cambridge, Mass., June 10, 1753. He served as a surgeon in the war of Independence, after which he practiced medicine in Boston, and was a member of Congress 1801–05 and 1820–23. He was Secretary of War from 1807 to 1813, resigning after Hull's surrender, and was minister to Holland from 1814 to 1818. In 1823 he was elected Governor of Massachusetts. D. in Boston, Feb. 6, 1825.

Eutaw: town (founded in 1839); capital of Greene co., Ala. (for location of county, see map of Alabama, ref. 4–B); on railway; 96 miles S. W. of Birmingham. It has 7 churches (4 for whites), 6 schools, a women's college, a saw-mill, 2 grist-mills, and 2 ginneries. Agriculture is the chief industry. Pop. (1900) 884.

Eutaw Indians: See SIOUAN INDIANS.

Eutheria [from Gr. εὖ, well + θηρίον, beast; i. e. the true beasts or mammals]: a term proposed by Gill for the viviparous mammals as opposed to the *Prototheria*, or egg-laying mammals, such as the ECHIDNA and ORNITHORHYNCHIDÆ (*qq. v.*). By Huxley and Flower the term is restricted to the placental mammals, or *Monodelphia*, the marsupials, or *Didelphia*, being placed apart as the *Metatheria.* F. A. L.

Euthyneu'ra [from Gr. εὐθύς, straight + νεῦρον, nerve]: a name given by Spengel to that group of gasteropod molluscs which includes the Opisthobranchs and Pulmonata, in allusion to the fact that the visceral nerves in these forms do not partake of the torsion of the body explained in the article GASTEROPODA (*q. v.*). J. S. K.

Eutro'pius, or **Flavius Eutropius**: a Latin historian who flourished about 350–370 A. D. The events of his life are mostly unknown, except that he was secretary under Constantine, and accompanied Julian in his expedition against the Persians. He wrote in ten books an *Epitome of Roman History* from the foundation of Rome to the time of Valens (*Breviarium ab Urbe Condita*), which became very popular, was translated into Greek, and has been extensively used as a school-book in modern times. His Latinity is pure and his style simple. The best editions are by Droysen (Berlin, 1879) and F. Rühl (Leipzig, 1887). M. W.

Eu'tyches (in Gr. Εὐτύχης): an aged superior of a monastery near Constantinople. He was a zealous opponent of the doctrines of the Nestorians, and was charged with teaching that there is in Christ only one nature—that is, the divine. He was condemned by the Council of Constantinople in 448 A. D., but this decision was reversed by the Council of Ephesus in 449. This triumph was obtained by the violent and disorderly acts of the soldiery and monks. The doctrines of Eutyches were again condemned as heretical by the general Council of Chalcedon in 451 A. D., soon after which he died. He was then above seventy years of age. The Eutychians were often called *Monophysites.* See MONOPHYSITES, JACOBITES, and CHRISTOLOGY.

Eutyches: Latin grammarian of the sixth century; pupil of Priscian. His treatise on the verb in two books is printed in vol. v. of Keil's edition of the *Grammatici Latini.*

Eutychianism: the doctrine with regard to the nature of Christ held by the followers of EUTYCHES (*q. v.*).

Euxine Sea: See BLACK SEA.

Evag'oras (in Gr. Εὐαγόρας): King of Salamis in Cyprus; was descended from Teucer, a famous hero. He began to reign in 410 B. C., and as an ally of the Athenians and Egyptians waged a long war against the King of Persia, who invaded Cyprus. He was assassinated in 374 B. C., and was succeeded by his son Nicocles.

Eva'grius: a Church historian; b. in Epiphania, on the Orontes, Cœla Syria, about 536; was at first a lawyer in Antioch, and defended the patriarch Gregory of Antioch before the Synod of Constantinople (589) from the charge of incest so well that he was appointed city questor by Tiberius Constantius and master of the rolls and prefect by the Emperor Mauricius. He continued the Church histories of Socrates and Theodoret in six books from 431–594. His Church history is compiled with great care and impartiality. The best edition was published by Reading (Cambridge, 1720). Eng. trans. in Bohn's Ecclesiastical Library.

Evangelical Alliance: a voluntary association of evangelical Christians from different churches and countries for the purpose of promoting religious liberty, Christian union, and co-operation in every good work. It owes its origin to a widespread and growing desire for a closer union among Protestants, both for its own sake and for a more successful conflict with infidelity on the one hand and superstition on the other. Its object is not to create a union, but to acknowledge, exhibit, and strengthen that spiritual union which has always existed among true Christians as members of Christ's body, but which is sadly marred and obstructed by the many divisions and rivalries of Protestant denominations and sects. It aims not at an organic union, nor at a confederation of churches as such, but simply at a free Christian union of individual members from different churches who hold essentially the same faith; although such a union will naturally tend to bring gradually the churches themselves into closer fellowship and mutual recognition. It claims no official and legislative authority that might in any way interfere with the internal affairs of the denominational organizations or the loyalty of its members to their particular communion. It relies solely on the moral power of truth and love. After a number of preparatory meetings and conferences, the Alliance was founded in a remarkable and enthusiastic meeting held in Freemasons' Hall, in London, Aug. 19–23, 1846, composed of some 800 Christians—Episcopalians, Presbyterians, Independents, Methodists, Baptists, Lutherans, Reformed, Moravians, and others, and including many of the most distinguished divines, preachers, and philanthropists from England, Scotland, Ireland, Germany, France, Switzerland, the U. S., and other countries. Sir Culling Eardly, Bart., presided, and became the first president of the British branch. Nine doctrinal articles were adopted; not, however, as a binding creed or confession, but simply as an expression of the essential consensus of evangelical Christians whom it seemed desirable to embrace in the Alliance. These articles are as follows:

1. The divine inspiration, authority, and sufficiency of the Holy Scriptures.
2. The right and duty of private judgment in the interpretation of the Holy Scriptures.
3. The Unity of the Godhead, and the Trinity of the persons therein.
4. The utter depravity of human nature in consequence of the Fall.
5. The incarnation of the Son of God, his work of atonement for the sins of mankind, and his mediatorial intercession and reign.
6. The justification of the sinner by faith alone.
7. The work of the Holy Spirit in the conversion and sanctification of the sinner.
8. The immortality of the soul, the resurrection of the body, the judgment of the world by our Lord Jesus Christ, with the eternal blessedness of the righteous and the eternal punishment of the wicked.
9. The divine institution of the Christian ministry, and the obligation and perpetuity of the ordinances of baptism and the Lord's Supper.

Some regard this doctrinal statement as too liberal, others as too narrow (especially on account of Art. 9, which excludes the Quakers, and Art. 8, which excludes the Universalists), while still others would have preferred no creed, or only the Apostles' Creed, the simplest and most generally accepted of all creeds. Nevertheless, it has answered a good purpose, and maintained the positive evangelical character of the Alliance. The American branch, at its organization (1867), adopted the nine London articles, with the following important explanatory and qualifying preamble:

Resolved, That in forming an Evangelical Alliance for the U. S. in co-operative union with other branches of the Alliance, we have no intention to give rise to a new denomination; or to effect an amalgamation of churches, except in the way of facilitating personal Christian intercourse and a mutual good understanding; or to interfere in any way whatever with the internal affairs of the various denominations; but simply to bring individual Christians into closer fellowship and co-operation, on the basis of the spiritual union which already exists in the vital relation of Christ to the members of his body in all ages and countries.

Resolved, That in the same spirit we propose no new creed; but, taking broad, historical, and evangelical catholic ground, we solemnly reaffirm and profess our faith in all the doctrines of the inspired word of God, and in the *consensus* of doctrines as held by all true Christians from the beginning. And we do more especially affirm our belief in the *divine-human person and atoning work of our Lord and Saviour Jesus Christ*, as the only and sufficient source of salvation, as the heart and soul of Christianity, and as the center of all true Christian union and fellowship.

Resolved, That, with this explanation, and in the spirit of a just Christian liberality in regard to the minor differences of theological schools and religious denominations, we also adopt, as a summary of the *consensus* of the various Evangelical Confessions of Faith, the Articles and Explanatory Statement set forth and agreed on by the Evangelical Alliance at its formation in London, 1846, and approved by the separate European organizations; which articles are as follows, etc.

The Evangelical Alliance thus auspiciously organized soon spread throughout the Protestant world. Branch Alliances were formed in Great Britain, Germany, France, Switzerland, Sweden, and even among the missionaries in Turkey and East India; also in Australia, in Brazil, and among the Protestant missionaries in Japan (Dec., 1873). There is no central organization with any controlling authority, and the General Alliance appears in active operation only from time to time when it meets in general conference, which has assumed the character of a Protestant œcumenical council, but differs from the œcumenical councils of the Greek and Roman Churches in claiming only moral and spiritual power. The various national branches are related to each other as members of a confederation with equal rights. The British branch, the oldest and largest, has the most complete organization, with a house in London; the continental branches are more elastic, and confine themselves to occasional work; the American branch, which was organized at the Bible House, New York, in 1867 (a previous attempt having failed on account of the anti-slavery agitation before the civil war), in a short time became the most vigorous and popular.

The Alliance assumed from the beginning that freedom of conscience and Christian union, far from being inconsistent with each other, are one and inseparable; that freedom is the basis of union, and union the result and support of freedom; that a union without freedom is only a dead mechanical uniformity; that true union implies variety and distinction, and a full recognition of the rights and peculiar gifts and mission of other members and branches of Christ's kingdom. The united efforts of the different branches of the Alliance, through the press and by deputations, have had a considerable moral influence in bringing about those remarkable changes in favor of religious liberty which have taken place among the Latin races and in Turkey. The Alliance aided in inducing the Sultan of Turkey to abolish the death penalty for apostasy from Mohammedanism in his dominions. It interceded for the Methodists and Baptists in Sweden, which has since abrogated the penal laws against Roman Catholics and Protestants not belonging to the Lutheran Confession. It sent in 1871 a large deputation, in which prominent citizens of the U. S. took the leading part, to the Czar of Russia to plead for the oppressed Lutherans in the Baltic Provinces. It sent a similar deputation to the embassy from Japan, when they visited the U. S. and the courts of Europe in 1872, to remonstrate against the persecution of Christians, mostly Roman Catholics, in that empire, and not long thereafter the persecution ceased.

As regards the cause of *Christian union*, the other great object of the Alliance, it is promoted mainly by means of general conferences of an international and inter-denominational character, which are arranged from time to time in different capitals by the branch in whose bounds it meets, with the co-operation of the sister branches. These meetings last from ten to twelve days, and are spent in prayer and praise, brotherly communion, and discussions of the most important religious questions of the age. Nine general conferences have been held so far. The first general conference took place in London in 1851, the year of the great exhibition of the works of industry of all nations in the British metropolis; the second in Paris, 1855; the third in Berlin, 1857; the fourth in Geneva, 1861; the fifth in Amsterdam, 1867; the sixth in New York, 1873; the seventh at Basel, Switzerland, 1879; the eighth at Copenhagen, Denmark, 1884; the ninth at Florence, Italy, 1891. The U. S. branch held a national conference, the tenth, in connection with the Columbian Exposition at Chicago, in Oct., 1893. PHILIP SCHAFF.

Evangelical Association, popularly but incorrectly known as the **German Methodist Church**: a body of American Christians, chiefly of German descent, organized by the Rev. Jacob Albright, a native of Eastern Pennsylvania. Regarding the doctrines and morals that prevailed in the German churches of that part of Pennsylvania as corrupt, Albright undertook about 1790 a work of reform among them. At a meeting of his converts in 1800, called for the purpose of deliberating on the measures best suited for advancing the new religious movement, Albright was unanimously elected pastor or bishop, and authorized to exercise all the functions of the ministerial office over the members of the organization. In the course of time annual conferences were established, and in 1816 the first general conference was held in Union co., Pa., consisting of all the elders in the ministry. Since 1843 the general conference, consisting of delegates from the annual conferences, has regularly met once every fourth year. During the first thirty years of its existence the Evangelical Association met with violent opposition, but since then it has quietly and rapidly advanced. As the Church repeatedly took action on the slavery question and sided with the anti-slavery churches, its progress was for many years wholly within the Northern States; but it now (1893) is represented in the South, though no conference has been established there. Differences of long standing led to a division in the Church in Oct., 1891.

In doctrine and theology the Evangelical Association is Arminian; with regard to sanctification, Wesleyan; in the form of government and mode of worship it generally agrees with the Methodist Episcopal Church (of which Albright, prior to beginning his reformatory labors in the German churches, was a member). The ministers, who, like the Methodists, practice itineracy, are divided into deacons and elders; the bishops and presiding elders are elected for a term of only four years—the former by the general conference, the latter by the individual conferences. The general conference is the highest legislative and judicial authority in the Church; the transactions of the annual and quarterly conferences are mostly of an executive and practical nature. A charitable society for the support of the widows and orphans of poor itinerant preachers was established in 1835, and a missionary society in 1838. There is, moreover, a Sunday-school and tract society, and church-building societies have been established in several conferences. A denominational publishing-house at Cleveland, O., publishes six periodicals—three in German and three in English; besides, two periodicals are published in Germany. The literary institutions of the Church are the Northwestern College, in Naperville, Ill.; the Union Seminary, in New Berlin, Pa.; the Blairstown Seminary, Blairstown, Ia.; and the Ebenezer Orphan Institution, at Flat Rock, O. In 1893 the Church had twenty-two annual conferences, inclusive of those of Canada and Germany; 1,864 ministers; 2,043 churches; and 148,506 members. See the history of the association, by W. Orwig.

Evangelical Church Conference: one of the periodical meetings of the Protestant state churches of Germany. The idea of these meetings originated with King William of Würtemberg in 1815. The first conference, held at Berlin in 1846, had representatives from almost every German state. At the second conference, held in 1852 at Eisenach, an official central organ was established at Stuttgart (*Allgemeine Kirchenblatt für das evangel. Deutschland*). The conferences are held at Eisenach every two years.

Evangelical Churches: those bodies of Christians which accept the Bible as the only rule of faith and practice, and believe in the divinity of Christ, in the necessity of his atonement, and in personal repentance and faith as essential to salvation.

"Evangelische Kirche" (Evangelical Church) is the official title of the Established Church of Prussia, formed in 1817 by the union of the Lutheran and the Reformed Churches. The Lutherans and Reformed (Calvinistic) Churches of Baden, Würtemberg, and other German states have been similarly united.

The "evangelical party" in the Church of England is that section of the Church which attaches especial importance to the teachings of the New Testament, and is charged with neglecting or slighting Church authority and underrating the efficacy of the sacraments.

Evangelical Counsels (Lat. *consilia evangelica*), or **Counsels of Perfection**: such directions or admonitions in the Roman Catholic Church as are not in themselves obligatory upon any one, but are recommended by the Church to some persons as highly advantageous to spiritual excellence. The chief evangelical counsels are voluntary celibacy, poverty, and obedience to monastic rules. Some writers reckon as evangelical counsels the scriptural recommendation to turn the left cheek to the man who has struck one's right cheek, to go two miles with a person who desires one's company for one mile, etc. There are reckoned twelve of these counsels.

Evangelical Union: a body of Scotch Independents, called **Morisonians**, from Rev. James Morison, their original leader. In 1843 they left the United Secession Church, and soon were joined by some Congregational churches of Scotland and England. They reject a part of the Calvinistic doctrines, and have a theological school at Glasgow. The three propositions for which Morison was deposed and on which the union was formed were that faith is one's belief in Christ's dying for him; that the "Spirit is poured out upon all flesh" and strives with all unbelievers; and that the atonement was universal. In 1889 the union embraced ninety-three churches. See Fergus Ferguson's *History of the Evangelical Union* (Glasgow, 1876).

Ev'ans, Arthur John: See the Appendix.

Evans, Augusta Jane (since 1868 *Mrs. L. M. Wilson*): novelist; b. near Columbus, Ga., May 8, 1835; removed in childhood, with her father, to Texas, and in 1849 removed to Mobile. She has published *Inez, a Tale of the Alamo* (New York, 1856); *Beulah* (1859); *Macaria* (1864); *St. Elmo* (1866); *Vashti* (1869); and *At the Mercy of Tiberius* (1887).

Evans, Sir De Lacy, D. C. L.: a British general; b. at Moig, Ireland, in 1787; served at Baltimore (1814), New Orleans (1815), and Waterloo (1815). He was a Liberal member of Parliament from 1831 to 1841. In 1835 he was appointed commander of a legion of 10,000 men raised in Great Britain to fight for the Queen of Spain. He defeated the Carlists at several places in 1836 and 1837. He represented Westminster in Parliament for many years, beginning in 1846. He became lieutenant-general, and commanded a division at the battle of the Alma and at Sebastopol in Oct., 1854. D. Jan. 9, 1870.

Evans, De Scott: See the Appendix.

Evans, Frederick William: lecturer and writer; b. in Leominster, England, June 9, 1808; removed in 1820 to the U. S. with his father. He became in theory a socialist, and studied the works of Owen, Fourier, and other leaders in the various projects for social reform. He visited England, and after his return went to visit the community of the United Society of Believers (Shakers) at Mt. Lebanon, N. Y., which he joined in 1830, and subsequently became the recognized leader of the Shakers in the U. S. His teachings added new dogmas and considerably modified the former doctrines of the Shakers. He was author of *Compendium of Principles, Rules, Doctrines, and Government of Shakers* (New York, 1859); *Autobiography of a Shaker* and *Tests of Divine Revelation* (1869); *Shaker Communism* (London, 1871); *Religious Communism* (1872); *Second Appearing of Christ* (1873); and other works. D. in Mt. Lebanon, N. Y., Mar. 6, 1893.

Evans, Sir John: See the Appendix.

Evans, Llewelyn Ioan, D. D., LL. D.: Welsh Presbyterian minister; b. at Treuddyn, near Mold, North Wales, June 27, 1833. His literary education was obtained at the Presbyterian College in Bala, North Wales, and at Racine College, Wisconsin, and Lane Theological Seminary, Cincinnati. He was a member of the Wisconsin Legislature 1856–57; pastor of the Seminary church, Cincinnati, 1860; Professor of Church History in Lane Seminary in 1863; of Biblical Literature and Exegesis in 1867; of New Testament Greek and Exegesis in 1875. In 1892 he returned to Wales as principal of the college at Bala. Besides publishing many sermons, pamphlets, and articles, he translated and edited *Zöckler's Commentary on Job*, in the American Lange series, 1874. D. at Bala, Wales, July 25, 1892. Willis J. Beecher.

Evans, Mary Ann, or Marian: See Eliot, George.

Evans, Oliver: inventor; b. in 1755 at Newport, Del. He invented the automatic flour-mill, the high-pressure steam-engine, a machine for making card-teeth, a steam dredge, and the boiler known as the "Cornish boiler." These important inventions brought him small pecuniary return, and his means were insufficient for the prosecution of his mechanical experiments. He wrote *The Young Engineer's Guide* (Philadelphia, 1805; French translation, Paris, 1821); *Miller and Millwright's Guide* (Philadelphia, 1797; Paris, 1830). D. in New York, Apr. 25, 1819.

Evans, Robley D.: See the Appendix.

Evanson, Edward: clergyman; b. at Warrington, Lancashire, Apr. 21, 1731. He studied theology at Cambridge, and became a minister of the Church of England, but was tried for heresy in 1775 in the consistorial court of Gloucester. He omitted or altered such phrases in the church service as seemed to him to be untrue; he corrected in accordance with his own views the authorized translation of the Scriptures; he contravened the creeds and the divinity of Christ, etc. The case was carried on appeal to the court of arches, and there it was buried, 1777. But in 1792 Evanson, who was now universally regarded as an unbeliever and practically out of the pale of the Church, published his *Dissonance of the Four Generally Received Evangelists*, in which he rejected most of the books of the New Testament as mere forgeries. He was answered by Thomas Falconer. D. at Colford, Gloucestershire, Sept. 25, 1805.

Evanston: town; Cook co., Ill. (for location of county, see map of Illinois, ref. 2–C); on railway, and on Lake Michigan; 12 miles N. of Chicago. It is a very handsome suburban town, the seat of NORTHWESTERN UNIVERSITY (*q. v.*) and the Garrett Biblical Institute, and has numerous churches. Pop. (1880) 6,703; (1890) 13,059; (1900) 19,259.
EDITOR OF "INDEX."

Evanston: town (founded in 1868); capital of Uintah co., Wyoming (for location of county, see map of Wyoming, ref. 12–F); situated on Bear river and on the Union Pacific Railway, 76 miles E. of Ogden. It is the seat of the State Asylum for the Insane, and has six churches, a high school, railway machine-shops (employing 200 men), a steam saw-mill, and a large flouring-mill. It is the center of a large region devoted to agriculture and stock-raising; in the vicinity are also valuable coal mines. Pop. (1880) 1,277; (1890) 1,995; (1900) 2,110. EDITOR OF "NEWS."

Evansville: city, railway center, and port of entry (incorporated in 1847); capital of Vanderburg co., Ind. (for location of county, see map of Indiana, ref. 11–B); pleasantly situated on a high bank on the Ohio river, 185 miles below Louisville and 192 miles above Cairo. It is the terminus of the E. and T. H., Peoria, Decatur and E., and Ohio Valley railways, and is 161 miles E. S. E. of St. Louis by the St. Louis and Southern Division of the L. and N. Railroad. It has 15 public schools, besides private and parochial schools, a fine U. S. custom-house and post-office, a U. S. marine hospital, one of the finest temperance halls in the country, 5 national banks, 2 savings banks, 8 flour-mills, foundries, machine-shops, and industries in wool, leather, etc. The census of the U. S. for 1890 shows 375 manufactories, with a capital of $8,432,384, giving employment to 6,766 persons, at an annual wage of $2,876,398. The cost of materials was $6,386,368; the value of product $11,788,672. Evansville is the principal shipping-point of Southwestern Indiana, and in commercial importance is one of the first cities in the State. Pop. (1880) 29,280; (1890) 50,756; (1900) 59,007. EDITOR OF "JOURNAL."

Evansville: village; Rock co., Wis. (for location, see map of Wisconsin, ref. 7–E); on Chi. and N. W. R. R.; 22 miles S. by E. of Madison. It has 5 churches, a seminary, a high school, 2 extensive tobacco warehouses, an iron-foundry, and a large windmill-factory. Pop. (1880) 1,068; (1890) 1,523; (1900) 1,864. EDITOR OF "REVIEW."

Evaporation [from Lat. *evapora'tio*, deriv. of *evapora're*, give forth steam; *e*, out + *vapor*, steam]: the passage of a substance from the liquid or solid state to the condition of vapor; especially such a change at a temperature below the boiling-point. Evaporation takes place in a vacuum more rapidly than in the air. It has been shown by Dalton that the elastic force of all vapors is the same, whether mixed with gas or air, or not; and that air is never truly saturated with vapor unless it contains an amount sufficient to saturate a vacuum of the same extent.

Evaporation is caused by heat which is absorbed when vapor is formed, and the most intense degree of cold known is caused by the evaporation of volatile liquids. The lowest point yet artificially produced, about −220° C., has been obtained by the evaporation in vacuo of liquid oxygen.

Ev'art: village; Osceola co., Mich. (for location, see map of Michigan, ref. 5–H); situated in the heart of a great lumber country; on the Flint and Pere Marquette Ry.; 60 miles E. of Ludington. It has saw and shingle mills, foundry and machine-shop, and is supplied with water-power. Pop. (1880) 1,302; (1890) 1,269; (1900) 1,360.

Evarts, WILLIAM MAXWELL, LL. D.: lawyer; b. in Boston, Mass., Feb. 6, 1818; graduated at Yale College in 1837; studied law, and in 1840 was admitted to the bar in the city of New York, where he practiced with great distinction. He was the leading counsel employed for the defense of President Johnson in his trial before the Senate in Apr. and May, 1868; Attorney-General of the U. S. from July, 1868, to Mar. 4, 1869; one of three lawyers appointed by President Grant in 1871 to defend the interests of citizens of the U. S. before the tribunal of arbitrators who met at Geneva to settle the Alabama claims; appointed Secretary of State by President Hayes Mar. 7, 1877; elected U. S. senator for New York Jan. 21, 1885. Among his public addresses are his eulogy on Chief Justice Chase (1873); Centennial Oration, in Philadelphia (1876); and the oration at the unveiling of Bartholdi's statue of Liberty. D. Feb. 29, 1901.

Eve, PAUL FITZSIMONS, M. D.: physician; b. near Augusta, Ga., June 27, 1806; graduated at the University of Georgia in 1826; graduated as M. D. at the University of Pennsylvania in 1828; studied several years in Europe; was a surgeon in the Polish revolution of 1831, and received the Golden Cross of Honor of Poland in that year; became Professor of Surgery in the Medical College of Georgia in 1832; in Louisville University (Kentucky) in 1849; in Nashville University (Tennessee) in 1850; and in Missouri Medical College, St. Louis, in 1868. In 1870 he became Professor of Operative and Clinical Surgery in the University of Nashville. Prof. Eve was president of the American Medical Association in 1857. He served as a surgeon in the Confederate army. He was editorially connected with professional journalism for many years, and was the author of very numerous monographs upon surgery, etc. D. in Nashville, Tenn., Nov. 3, 1877.

Evection [from Lat. *evectio*, act of carrying out; *e*, out + *ve'here*, *vec'tum*, carry]: an inequality of the moon's motion, depending on the position of the transverse axis of the moon's orbit, as compared with the earth's radius vector. The eccentricity of the lunar orbit varies with the relative position of these lines. It is maximum when they are coincident, and minimum when they are perpendicular to each other.

Evelyn, JOHN: author; b. at Wotton, Surrey, Oct. 31, 1620; educated at Baliol College, Oxford; traveled abroad from 1641 to 1652; enjoyed great favor at the court after the Restoration, and held various positions of honor and trust, but no office. He was a very prolific writer, and published *Sylva*, an elaborate treatise on arboriculture; *Navigation and Commerce, their Origin and Progress*; an introduction to a history of the Dutch war, which he began, but never finished; *A Parallel of Ancient and Modern Architecture*, etc. But his most important and most interesting work is his *Diary*, written without any idea of publication and containing numerous contributions to the history of the time. The sixth edition, with his *Life* prefixed, was published in 1879. D. in London, Feb. 27, 1706.

Evelyn College: an institution for the education of young women, situated at Princeton, N. J. It was established in 1887; legally incorporated in 1889, and formally authorized to confer degrees. In the same year resolutions were passed by the board of trustees of Princeton University granting to the students of Evelyn all necessary use of the Princeton libraries and museums. In 1890 the increased number of students made it necessary to secure a second building. The board of trustees consists principally of professors and trustees of Princeton University and Theological Seminary. The classes are mainly in charge of the professors in Princeton University and their assistants, and any course of study given at Princeton can be made available for the students of Evelyn. There is no co-educational element, and the work is wholly separate from that of Princeton University. There is a preparatory school in connection with the institution. The students in residence are divided into families of from fifteen to twenty each, in order to secure healthful home influences.

Evening Schools: institutions established in many of the larger towns of Great Britain and Ireland, and in the most of the cities of the U. S., for the instruction of artisans and others who have been unable to receive education in childhood. In some instances such schools are maintained by private benevolence, but they are generally established and maintained by local or municipal authorities. See EDUCATION, MANUAL TRAINING, and SCHOOLS.

Everest, HARVEY W.: preacher, teacher, and author; b. at North Hudson, Essex co., N. Y., May 10, 1831; educated at Geauga Seminary, Ohio, the Western Reserve Eclectic Institute, Bethany College, and Oberlin; president of Eureka College, professor in Kentucky University, president of Butler University, and chancellor of Garfield University. His work, *The Divine Demonstration—a Text-book of Christian Evidence*, is used in many colleges. He is pastor of the Christian church (Disciples) at Hutchinson, Kan.
J. H. GARRISON.

Ev'erest, Mount: the highest mountain of the earth; in the eastern range of the Himalayas, in Northern Nepaul; lat. 27° 59′ 12″ N., lon. 86° 58′ 6″ E. According to the measurement of Waugh in 1856, the altitude is 29,002 feet.

Everett: city (incorporated 1893): Middlesex co., Mass. (for location of county, see map of Massachusetts, ref. 2–H);

on the Eastern Division and Saugus Branch of the Boston and Maine Railroad; adjoining Boston, Chelsea, and Malden, of which last it formed part until incorporated as a town in 1870. It has 7 churches, 7 schools, a high school with a library of 8,000 volumes, large chemical works, and a number of small manufactories. Pop. (1880) 4,159; (1890) 11,068; (1900) 24,336. EDITOR OF "FREE PRESS."

Everett: borough; Bedford co., Pa. (for location of county, see map of Pennsylvania, ref. 6–D); on railway; 100 miles E. S. E. of Pittsburg. It has 8 churches, 2 public schools, an iron-furnace, glass-works, 2 tanneries, a flouring-mill, and 3 planing-mills. Pop. (1880) 1,247; (1890) 1,679; (1900) 1,864. EDITORS OF "PRESS."

Everett, ALEXANDER HILL, LL. D.: a scholar and diplomatist; b. in Boston, Mar. 19, 1792; a brother of Edward Everett; graduated at Harvard in 1806, and studied law in the office of John Q. Adams, with whom he went to Russia as secretary of legation in 1809. He was *chargé d'affaires* at The Hague for nearly six years (1818–24), and published in 1821 an able work entitled *Europe, or a General Survey of the Principal Powers*, etc. In 1825 he was appointed minister to the court of Spain by President Adams. During his residence at Madrid he wrote *America, or a General Survey of the Political Situation of the Several Powers of the Western Continent* (1827). He returned in 1829, and became editor of the *North American Review*, to which he contributed many articles. In 1845 he was appointed commissioner to China. D. at Canton, June 29, 1847.

Everett, CHARLES CARROLL, D. D.: philosopher; b. in Brunswick, Me., June 19, 1829; graduated at Bowdoin College in 1850; studied at Harvard Divinity School and at the University of Berlin; librarian, tutor, and Professor of Modern Languages at Bowdoin from 1853 till 1857; after graduating at Harvard Divinity School, in 1859, settled over a Unitarian church in Bangor; in 1869 became Professor of Theology at Harvard, and in 1878 dean of the divinity school; published *The Science of Thought* (Boston, 1869); *Religions before Christianity* (Boston, 1883); *Fichte's Science of Knowledge* (Chicago, 1884); *Poetry, Comedy, and Duty* (Boston, 1888); *Ethics for Young People* (Boston, 1891); *The Gospel of St. Paul* (1892). His philosophy is deeply tinged with that of Hegel, but without sacrifice of his individual quality, and is much enforced and illustrated from his scientific studies. D. Oct. 17, 1900.

Everett, EDWARD, LL. D., D. C. L.: orator and statesman; b. in Dorchester, Mass., Apr. 11, 1794; a son of Rev. Oliver Everett, who died in 1802. He was twice a Franklin medal scholar of the Boston public schools, and for a few months a pupil of the Phillips Exeter Academy. In 1811 he graduated at Harvard College with the highest honors of his class, being then little more than seventeen years of age. In 1812 he was appointed a tutor at Harvard while pursuing theological studies, and in 1814 he was ordained as pastor of the Brattle Street (Unitarian) Church in Boston. In Mar., 1815, he accepted the Eliot professorship of Greek literature at Harvard, the duties of which he assumed in 1819, after a course of study at Göttingen and extensive travels in Europe and the East. A brilliant course of lectures on ancient Greece and its architecture inaugurated his accession to the professorial chair, which he held until 1825. His fame as a secular orator was increased by a Phi Beta Kappa oration, delivered at Cambridge in 1824, in the presence of Lafayette, and an oration on the Pilgrim Fathers, delivered at Plymouth, on Dec. 22 of that year. Mr. Everett represented the district of Middlesex in Congress from 1825 to 1835; he was elected Governor of Massachusetts, and was annually re-elected until 1840, when he was defeated by a single vote out of more than a hundred thousand. He returned to Europe in 1840 and settled in Florence in order to devote himself to the writing of history, but in about a year was appointed minister plenipotentiary of the U. S. to Great Britain. He entered upon that mission in 1841 at a moment when questions of the greatest delicacy were pending between the two nations. Returning home in 1845, he was offered the presidency of Harvard College, which he accepted and held for three years. He then re-established himself in Boston, for the purpose of resuming literary work. The death of Mr. Webster in Nov., 1852, left a vacancy in the Department of State at Washington, which Mr. Everett was immediately summoned to fill; and on the expiration of his brief term as Secretary of State, by the termination of President Fillmore's administration in 1853, he was elected by the Legislature of Massachusetts a Senator in Congress. He held that place but a single year, when, owing to ill-health, he retired. In 1860 he accepted a nomination for the vice-presidency of the U. S., but failed of an election; and the last ten years of his life were spent in the exercise of his oratorical powers in behalf of some charitable institution, or in commemorating some historical event, or in eulogizing some illustrious person. During the first half of these last ten years his topics were within the common range of occasional discourses. To this period also belongs the memorable and patriotic pilgrimage made for the purpose of rescuing Mt. Vernon from the danger of falling into the hands of speculators, and of securing it as a national possession. His address on *The Character of Washington* was delivered in all quarters of the Union, and Mr. Everett paid over about $60,000 to the treasurer of the fund as the product of his eloquence. The opening of the civil war gave a new field to the labors of his pen and of his tongue, and from *The Flag-raising in Chester Square* (Boston), on Apr. 27, 1861, to his last utterance for *The Relief of Savannah*, in Faneuil Hall, on Jan. 9, 1865, his thoughts, his time, and almost all his numerous addresses, filling nearly 350 pages of an octavo volume, were given to the support of the Union cause. He received the highest literary honors from Cambridge and Oxford, and the Institute of France enrolled him as a corresponding member. At home he enjoyed the life-long intimacy and confidence of Daniel Webster, whose collected works he edited and published in 1851 in six volumes with a carefully written biography in the first volume. In 1822 he married Miss Charlotte Gray, daughter of the Hon. Peter Chardon Brooks, a distinguished merchant of Boston, of whom he prepared an elaborate memoir, which is included in the third volume of his *Orations and Speeches*. Two sons and a daughter survived him. D. in Boston, Jan. 15, 1865.

Revised by C. K. ADAMS.

Everett, WILLIAM, Ph. D.: author and teacher; youngest son of Edward Everett; b. in Watertown, Mass., Oct. 10, 1839; graduated at Harvard College in 1859 and at Trinity College (England) in 1863; was assistant Professor of Latin at Harvard 1872–77; became master of Adams Academy, Quincy, Mass., in 1878, and member of Congress in 1893. He has published *On the Cam* (lectures, 1865); *Changing Base* (1868); *Hesione* (poem, 1869); *Double Play* (1870); and *School Sermons* (1881).

Everglades: an extensive marshy region in Southern Florida, S. of Lake Okeechobee, consisting of a great shallow lake, in which are many low islands, varying in size from a few square yards to hundreds of acres, and covered with a dense jungle of pines, palmettoes, vines, and tropical trees. The water between the islands is from 1 to 6 feet deep. This region is a recently raised sea-bottom whose drainage is as yet imperfectly developed. As the streams gradually sink their channels into the level tract it will become drained, as is the case with the pine-land plains of New Jersey.

Evergreen: town; capital of Conecuh co., Ala. (for location of county, see map of Alabama, ref. 6–C); 97 miles N. E. of Mobile. The principal industry is truck farming. The town has medicinal springs, and is a place of winter resort, visited yearly by large numbers of Northern tourists. Pop. (1880) 985; (1890) 1,783; (1900) 1,277. EDITOR OF "STAR."

Evergreens: plants which hold their leaves throughout the winter. Horticulturists usually speak of two classes of evergreen plants, the broad-leaved, like the laurels and mahonias, and the narrow-leaved, or coniferous, including the pines and spruces, but many of the conifers, which are commonly considered evergreens, have deciduous leaves, as the larches and bald cypress. The leaves of some evergreen plants persist little more than a year, but they do not fall until new ones have appeared. The leaves of pines and spruces fall when from two to six or even more years old.

L. H. BAILEY.

Everlasting Flowers: the common name of several genera of the order *Compositæ*, having flowers which if dried and preserved retain their form and color many years. They are often called immortelles.

Evesham: town of Worcestershire, England; on the navigable river Avon, here crossed by a stone bridge of eight arches, and in the beautiful Vale of Evesham, 15 miles S. E. of Worcester (see map of England, ref. 11–G). It has remains of an abbey built about 700 A. D. Most of the surrounding country is occupied by market-gardens. Here Edward, Prince of Wales, afterward Edward I., defeated Simon de Montfort and the barons on Aug. 4, 1265. Pop. (1891) 5,836.

Eviction [from Lat. *evin'cere*, to triumph, to get control by dispossessing; *e*, out + *vincere, victum*, conquer]: in law, the act of dispossessing one of lands or tenements, as when a landlord ejects a tenant who is in arrears in his rent, or when a third person dispossesses a tenant by means of a title superior to that of the landlord, or a vendee by a title superior to that of the vendor. Originally eviction, as a legal term, was applied only to a dispossession by judgment of law, but it is now used to denote a dispossession under paramount title, or claim of paramount title, as well as many acts done by the landlord to impair the enjoyment of the premises which in intendment of law amount to a dispossession of the tenant and justify him in leaving them. In such cases, however, he must actually leave, or otherwise he can not claim to have been evicted. When the grantee of premises, with a covenant of warranty, is evicted, the damages recoverable are, in general, the consideration-money, with interest. In case of a lessee, however, as the rent ceases on eviction, he can, as a general rule, recover only the expenses of defending his possession. When the eviction is only from a part of the premises, the rent or damages is in many cases apportioned.

Revised by F. STURGES ALLEN.

Evidence [viâ Fr. from Lat. *eviden'tia*, clear view, clearness; *e*, out, fully + *vide're*, see]: in law, the means of establishing an allegation made in a court of justice. In an action the respective parties make written statements of their cause of action and defense. The matter thus in dispute between them is called an issue. The object of evidence is to establish or disprove the propositions alleged. The result of the evidence is called proof. Evidence may be considered under a number of divisions: 1. Its nature and the doctrine of presumptions; 2. The rules that govern in the production and exclusion of testimony; 3. Its effect; 4. The instruments of evidence, including witnesses, and the mode of making use of them as well as writings.

1. *Its Nature, etc.*—The object of evidence is to establish a fact. It presupposes a disposition in the mind of a listener to believe upon sufficient grounds. Belief on the part of mankind is instinctive, yet this instinct is modified by the results of observation and reflection. When evidence is offered in a court of justice, it is assumed to be addressed to minds competent to give it such weight as its quality justifies. It may be either *direct* or *circumstantial.* It is said to be direct when it is offered simply to establish the fact which it concerns; it is circumstantial when its object is to lead the mind of the hearer to *deduce* or *infer* some other fact from it. In the case of circumstantial evidence the minds of the jury or judge, as the case may be, go through a process of reasoning to arrive at the principal fact in dispute. It must be resorted to with caution, in order that the conclusion arrived at may be sound and logical.

Reference may now be made to the subject of presumptions. These are of two kinds—of law and of fact. Presumptions of law are either conclusive or disputable. A conclusive presumption of law takes place when a legal conclusion is arrived at which no evidence is admissible to rebut. This doctrine is based largely on public policy, and leads to a series of artificial and arbitrary subordinate rules. An illustration is that a child under seven years of age can not commit a felonious crime. The doctrine of estoppel is another illustration. When evidence can be offered to rebut a presumption of law, it is said to be disputable. An instance is the ordinary rule in criminal law that one charged with crime is presumed to be innocent until he is proved to be guilty, or that one having possession of stolen goods immediately after a theft became possessed of them unlawfully. Under this theory, when a state of facts is once established, it is presumed to exist until there is some evidence to the contrary. Thus a man engaged in trade is assumed to follow the ordinary course of business, or the incumbent of a public office to perform its duties in the usual manner. Life is presumed to continue unless there is evidence of death, or sanity until evidence is offered to establish insanity. A presumption of fact is not a rule of law which can be announced to a jury as binding upon them, but in each case must be found by them as a matter of fact, though the court may direct their attention to the propriety of forming the conclusion. An illustration is the testimony of an accomplice, which is generally deemed to be untrustworthy without corroboration from other and trustworthy sources, and an observation to that effect may be made by the judge. Still the jury has the legal power to find a verdict upon the uncorroborated testimony of an accomplice.

2. *The Rules which prevail as to the Production of Evidence.*—The leading rules are the following: Rule 1. Certain matters may be judicially taken notice of without proof; Rule 2. Evidence must correspond with the allegations in the pleadings, and be confined to the points in issue; Rule 3. Only the substance of the issue need be proved; Rule 4. The burden of proof is with him who holds the affirmative; Rule 5. The best evidence must be produced of which the nature of the case admits; Rule 6. Hearsay evidence is in general inadmissible; Rule 7. Testimony should in general concern matters of knowledge as distinguished from opinion (though to this rule there are well-established exceptions); Rule 8. Certain evidence, otherwise admissible, is excluded on grounds of public policy; Rule 9. In certain cases, principally by statute law, written evidence must be resorted to rather than oral; Rule 10. Oral contemporaneous evidence is not admissible to vary the terms of a written instrument. These rules require some explanation. It should be premised, however, that on a trial, with or without a jury, it rests with a judge to determine whether the evidence is admissible under these rules. Whichever way he may decide, the opposing party may except, and make his exception the subject of an appeal.

Rule 1. There are certain facts of general knowledge in respect to which it is not worth while to take up time to adduce evidence, such as the recurrence of the seasons. The same rule applies to the existence of foreign nations recognized by the executive power of the nation, and to general statutes of the legislature. Of such facts a court is said to take judicial notice, and, if necessary, may resort for information to books and other sources of knowledge.

Rule 2. The second rule excludes all immaterial evidence, and confines the trial to matters in issue. Immaterial allegations in the pleadings can not be proved. For example, evidence of the intent of a party would not be admissible unless intent was material; and the same remark may be applied to evidence of good or bad character. In an action to recover money loaned, evidence of the bad intent of the debtor in delaying payment, or of the creditor's bad character, would be plainly inadmissible, while in an action for slander the plaintiff's character would be to a certain extent in issue.

Rule 3. This rule means that the minor and unimportant allegations relating to the issue need not be established as stated. They are such as the statements respecting the time or place where an event occurred, or the value of an item of property. Still, even allegations in their nature unimportant may become material by the mode in which they are stated, as if they are made descriptive. In such a case a difference between the pleadings and the evidence, called a variance, may be fatal. The effect of this stringent rule has in a number of the States of the U. S. been greatly modified as to civil actions by statutes of amendments. The criminal law is still disfigured by extreme technicality in this respect, and needs the hand of a discreet reformer to subserve the interests of the public by removing all useless impediments to the due administration of justice.

Rule 4. Under this rule he who makes an allegation which is disputed, so as to be at issue, must establish it by evidence. The burden of proof is usually with the plaintiff, though in some instances it devolves upon the defendant, as where he admits the plaintiff's case, but seeks to avoid its effect by new allegations—as, for example, infancy. The person who has the burden of proof has the right to open the case and close it. This in jury trials is often deemed to be a matter of much importance, so that each of the respective parties insists on an adjudication that the burden of proof belongs to him.

Rule 5. Under this rule evidence is divided into primary and secondary. If the primary evidence is accessible, it must in general be produced; if it be lost or destroyed, resort may be had to that which is secondary. Thus where the law requires a contract to be reduced to writing, or where the parties have written out a contract which might have been oral, the written instrument must itself be produced if it can be obtained. The rule is relaxed in certain cases where public convenience may require it. For this reason a public record may be proved by an authorized copy, without the production of the record itself.

Rule 6. The word hearsay is infelicitous, including not only what is said, but what is written, or even acted. The rule means that evidence must be given in by one who is personally cognizant of the fact to be proved, and not by one who may have gained his knowledge at second hand, from the act or narration of another. Bentham distinguished between a "perceiving" and a "narrating" witness with the same general view. The reasons for excluding hearsay evidence are obvious. Great care must be taken in distinguishing between hearsay evidence and that which is original. Thus when the very subject of inquiry is whether a certain thing was or was not said by a person, evidence that it was said is clearly admissible. So when a statement forms a part of the transaction, or, in technical language, *res gestæ*, evidence of it is not hearsay. Where the testimony is clearly hearsay, there are certain exceptional instances in which it is admissible, as in matters of public or general interest, or of ancient possessions, or of dying declarations in cases of homicide. It should be added that the admissions or confessions, when voluntary, of a party to an action are received in evidence against him on mixed grounds, partly as a substitute for more regular methods of proof, and partly as a branch of the law of *res gestæ*.

Rule 7. Under this rule a witness must in general testify only to facts of which he is personally cognizant, without giving his opinion as to their effect. There is a class of witnesses, termed experts, who are allowed to give their opinions upon facts of which they have no personal knowledge. For example, the testimony of persons acquainted with the facts may be read over to the expert, and his opinion asked as to the conclusion which should be drawn from it; or a hypothetical question, embracing the facts assumed to be established, may be put to him. An expert is one skilled in a particular trade, art, or profession. An instance is the superintendent of an asylum for the insane as to matters connected with the subject of insanity. There are a few instances in which persons who are not experts are from the necessity of the case, or by a special rule of law, allowed to testify as to their opinions.

Rule 8. This rule shuts out evidence in a number of cases where strong reasons of a public nature demand that it should be excluded. A leading instance is that of confidential communications between an attorney and client, and similar communications between husband and wife. It also prevents a judicial inquiry into secrets of state, and, to a certain extent, into the deliberations of judges in forming a judgment or of juries in arriving at a verdict.

Rule 9. There is a great statute in the English law, termed the statute of frauds, requiring certain transactions to be evidenced by writing, such as conveyances or leases of land, wills of land, and some executory contracts, as, for example, contracts to convey land or to be answerable for the debt of another. These are but instances of a more extended class of cases. Without the writing as evidence these contracts or transactions can not be established. It should, however, be added, that if such contracts, etc., have once been written and can not be produced, their contents may be proved by oral evidence.

Rule 10. This is an inflexible rule, applicable to contracts, wills, etc. Even if a contract need not have been written, yet if the parties choose to have it so, no contemporaneous oral evidence can be offered to show different or additional terms. There is a conclusive presumption of law that the parties intended to merge all anterior and contemporaneous propositions in the writing. That is the sole repository of their intention; the rule, from the nature of the case, does not preclude oral proof of a subsequent modification of the contract, nor does it prevent the introduction of oral evidence to explain the writing. Thus the meaning of technical words may be shown by the testimony of experts, and oral evidence may be used to show the circumstances surrounding the transaction, so as to place the court in the position of the parties. This is a rule of interpretation. It assumes that the instrument is valid. When the validity of the instrument itself comes in question the rule has no application. Oral evidence may accordingly be offered to show that the instrument is void. So if a clause has been omitted or inserted by mistake, a court of equity will, on sufficient oral evidence, rectify the instrument, or, in technical language, reform it, and give it the form intended by the parties.

3. *The Effect of Evidence.*—In general, evidence is to be weighed by the jury or judge, as the case may be, and a decision to be rendered in view of all the circumstances of the case. In some instances its effect is governed by technical rules. This remark is particularly applicable to matters embraced under the head of ESTOPPEL (*q. v.*). The evidence in this class of cases is conclusive. The most important instance of the application of this principle is that of a judgment recovered in a court of justice. Judgments are of two general classes—*in rem* and *in personam*. In the one case the action or proceeding is instituted against a thing, such as a ship or article of merchandise, to fix its ownership, or to establish the status of a person, as to have an adjudication that he is a lunatic, and the judgment is conclusive evidence against all as to the matters adjudicated upon. An action *in personam* is brought against a person to obtain a judicial declaration or sentence concerning his duty or obligation, as in an action for damages for a breach of contract. A judgment in this class of cases is conclusive evidence only when given upon the merits, and as to matters expressly or by necessary implication involved in the issue, and as to these only between the parties to the action and those claiming under them.

It should be added that in some cases the law gives to certain acts the force of *primâ facie* evidence, which, as the phrase implies, is liable to be rebutted. Thus a promissory note is presumptively made upon a valuable consideration. Statute law frequently declares that a particular transaction shall have this force. The rules of evidence are under the control of the legislature so long as they do not impair vested rights or violate in any manner constitutional law in its letter or spirit.

4. *The Instruments of Evidence.*—These are either witnesses or writings. (1) *Witnesses.*—A witness, when within the jurisdiction of the court, must in general attend in person. He can be compelled to attend by a writ termed a subpœna, and in the same way to bring writings which are required. When beyond the jurisdiction, his testimony is taken under a commission issuing from the court in which the case is pending. This matter is in some respects governed by statute, though in some of the courts, as in equity and admiralty, there is an inherent power to issue commissions. The testimony, when taken in the foreign country, is returned to the court, subject to any objections which may properly be taken to it. Certain classes of persons are excluded from testifying. The rules upon this subject are to some extent arbitrary. They have been modified in recent times by statute. Thus parties to the action were at one time wholly excluded in the courts of common law. They are now by statutes generally admitted. The same remarks may be made as to persons having a pecuniary interest in the event of the litigation. Persons are still incompetent who have a defect of understanding, or who are supposed to be insensible to the obligations of an oath. Thus persons convicted of an infamous crime are excluded from testifying in the courts of the State where the conviction took place. The tendency of modern law is to allow as wide a range as possible, and to permit objections to witnesses which were formerly grounds of exclusion to be only urged as affecting the value of their testimony. In technical language the objection does not go "to the competency, but to the credibility of the witness." The examination of witnesses is governed by rules which are to some extent discretionary, and in other respects absolutely binding. The principal rules are these: *a.* Leading questions are not, in general, to be asked on the direct examination. *b.* The party calling the witness can not attack his character, though he may show by independent testimony that his version of the facts is not correct. *c.* The range of cross-examination is much wider than the direct, and leading questions are permissible. A witness can not on cross-examination be asked a collateral question for the purpose of contradicting him in case his answer should be untrue. He may, however, be asked, under proper limitations, with a view to contradiction and the discredit of his testimony, if he has not given out of court a different version of the facts from that to which he now testifies, and in the same way as to expressions of hostility toward the party against whom the testimony is given. *d.* A witness is privileged from answering a question if such answer would tend to convict him of a crime or to subject him to a penalty or a forfeiture, though this rule would not extend to the case where he might simply be made liable in a civil action for a debt, etc. How far he can refuse to answer a question which if answered would tend to degrade him in the estimation of his fellows is not fully settled. *e.* The character

of a witness may be attacked by the opposing party, either by direct evidence of his bad character, or rather reputation, or by showing that he has from time to time given different versions of the facts. *f.* A cross-examination is to be confined to the matters brought out on the direct examination, and the same remark is applicable to the redirect and subsequent examinations. (2) *Writings* for the purposes of the law of evidence are either public or private. Public writings are either judicial or not judicial. The law provides compulsory modes of producing public writings for the purposes of testimony. Copies are in general resorted to, on grounds of public convenience. The officer having the document in custody has, in general, the power to give a certified copy, which is admissible in evidence. Copies of judicial records are of three varieties: exemplified (a copy either under the great seal of state or under the seal of the court), office (certified by the clerk or other custodian), or sworn. A sworn copy is authenticated by the testimony of a witness who has compared the original with the copy. An act of Congress, authorized by the U. S. Constitution, provides a convenient mode of authenticating a judgment or decree of the courts of record of one State to be used in the courts of another State. Should a record be destroyed, its contents may be proved by oral evidence. A private writing is proved by the production of the writing itself, and its existence established by the testimony of a witness. Where the writing can not be produced, secondary evidence of its contents may be given. In the special case where it is in the possession of the opposite party reasonable notice should be given to him to produce it at the trial. If he fails to produce it, secondary evidence may be given as before. When a private writing is executed in the presence of a witness subscribing his name at the request of the maker of it, this witness, called a "subscribing witness," is the proper person to prove it. If he be dead, or for any sufficient reason can not be produced, his handwriting may be proved, with some evidence to identify the party to the action as being the person who executed the instrument. When there is no subscribing witness, the proper course is to call a witness acquainted with the handwriting of the maker of the instrument to testify that in his opinion the instrument or the signature is in the handwriting of the party. Though this is matter of opinion, it is admitted from the necessity of the case. Knowledge of the handwriting may be acquired in various modes, usually by seeing the person write or by having transactions or correspondence with him. The testimony of experts as to handwriting is in some cases admitted, though the law as to the extent to which they may be examined varies in different States. In some of the States there are convenient statutory modes of proving private writings. A single instance may be cited from the law of New York, which allows nearly every contract, if acknowledged by the maker before an authorized officer, such as a notary public, to be put in evidence without other testimony by way of authentication

The final remark may be made that the rules of evidence, though positive and in some respects arbitrary, are largely based upon public convenience, and are adapted to the wants and habits of the community. T. W. DWIGHT.

Evidences of Christianity, The: proofs of the divine origin of the religion founded by Jesus Christ. The evidences of Christianity, by the very fact of their existence, afford a strong presumption in its favor. They place it before the world as at least claiming to be founded in truth and suited to the reason of man. Had it made its way by mere force and policy, or did it now require assent without testimony and argument, there would be no need even to investigate its merits. It might be classed at once with the false religions which are confessedly without reasonable evidence, if not beneath discussion. But in distinction from all other systems it possesses a recognized body of proof which has been accumulating for eighteen centuries under the most varied and searching criticism, and which, when examined, is found to be all that the case admits or that an intelligent inquirer could demand. Such an inquirer may therefore be challenged at the threshold to acquaint himself with the history of the Christian evidences before he proceeds to judge them in detail.

History of the Christian Evidences.—The history of Christianity is, in one view, but the history of its evidences. Externally, at least, its course through the world has been marked by successive crises, when it encountered various forms of incredulity which it became necessary to repel with suitable evidence; and out of every such conflict it has emerged with a triumphant vindication of its claims and a fresh contribution of proof to later generations.

Its first conflict was with Judaism. On its native soil and at its very origin it excited the bitter unbelief of the Jewish rulers and people, who repudiated it as an impious caricature of their own ancient religion, stigmatized its author as an impostor or false Messiah, and at length compelled him by the death of the cross to become the first great martyr to its truth. Judaism, as a distinct system, from that moment declined into a mere dead tradition, and has since, by its own predicted fate, served but as an unwilling witness for that Christianity which has been spreading over the globe and becoming the common heritage of all nations and races. The life and death of our Lord, including his discourses, parables, and miracles, as recorded in the four Gospels, constitute the evidences of Christianity afforded at its origin.

Its next conflict was with paganism. No sooner had it been proclaimed outside of Judæa as a gospel to the nations than it encountered the decaying religions of Greece and Rome, which desperately rallied against it as a common enemy. But its course from city to city was marked with crowds of converts, as well as with persecutions and conflicts, everywhere accelerating the decline of those old mythologies, which now figure only in the classic literature made tributary to its own defense and illustration. The planting and training of the Church, as narrated in the Acts and Epistles of the apostles, together with the Apologies of Justin, Tatian, Athenagoras, and Theophilus, yield the evidences belonging to this period.

Its next conflict was with philosophy. So long as it was contending with mere Jewish and heathen superstitions the learned class could treat it with disdainful silence, such great writers as Plutarch, Seneca, and Tacitus alluding to it only in the most distant manner; but as its exclusive claims gradually became known, its advance was met by an infidel wing of the Neoplatonic school, led by Celsus, Porphyry, and Hierocles, who assailed it as a vulgar imposture, and at length provoked the series of bloody persecutions which filled the cities of the empire with Christian martyrs. Its apparent defeat, however, was followed by a victory almost ruinous. It had already won from the very ranks of Plato its first great apologist, Justin Martyr, and it now wrested so much of philosophy itself as could be wrought into its own theology; and at length appeared upon the throne of Constantine as the visible head of a new Christian civilization. Besides these worldly trophies, its direct evidences for this period are to be found in the testimony of the martyrs and the apologetical writings of Tertullian, Clement, Origen, Eusebius, Cyril, Arnobius, Lactantius, and Augustine.

Its next conflict was with barbarism. In the Dark Ages following the barbarian conquest and the wreck of the Roman empire, though it was now deprived of all earthly aid, it subdued the rude religions of the North as it had already vanquished the classic mythologies of the South, and treasured up from the civilization of the past all that was valuable for that of the future. While contending with such savage foes it could have no other evidences than such as appeared practically in the Germanic missions and in the great Christian schools of the Middle Ages.

Its next conflict was with Mohammedanism. The Saracen was invading its domains with the sword and the Koran from the East to the shores of Spain; but the fierce Goths whom it had trained into Christian knights now by successive crusades battled for the tomb of the Saviour, until Europe was delivered from the infidel. Its evidences for this epoch were all that could be expected—the exploits of Christian chivalry, the prizes wrested from Arabian learning, and the apologetical writings of the Schoolmen against the Jews and Mohammedans in Moorish Spain.

Its next conflict was with modern rationalism. Divided at the Reformation into Catholicism and Protestantism, it encountered a treacherous foe which for several centuries, under various guises, has been subjecting its divine revelations to the test of mere human reason. But hitherto the strength of its evidences has only been proved by each successive assault. The Italian naturalists of the sixteenth century, such as Pomponatius, Cæsalpin, and Cremoninus, who held Aristotelian opinions subversive of revealed religion at the very court of Rome and under feigned respect to the Church, wrought their own defeat by their shameless hypocrisy and vice. The English deists of the seventeenth century (such as Herbert, Hobbes, and Toland) and of the eighteenth century (such as Collins, Tyndal, and Bolingbroke), who professed mere natural religion as essential Christianity, were so completely repulsed by the great apologists, Cudworth, Bentley, Berkeley, and Butler, that their very works have become obsolete or linger only as brilliant names in literature. The French atheists of the eighteenth century, such as Helvetius, Diderot, and d'Holbach, who assailed Christian morality itself with a sensual fatalism, only precipitated that terrible revolution which made them infamous as enemies of civilization, no less than of religion. The German pantheists of the nineteenth century, such as Strauss, Bauer, and Feuerbach, who had been striving to resolve Christianity into mere mythology, were routed upon their own ground and with their own weapons by such learned and acute writers as Neander, Ebrard, and Ullmann. And it is safe to predict that the sciolists who are opposing it with science falsely so called are but insuring a like failure and defeat.

But the still remaining and perhaps final conflict is to be with modern heathenism. Having developed for itself in the Western nations of Europe and America a civilization the highest the world has yet ever seen, it would be strange if it could not cope with those Eastern nations of Asia and Africa which meanwhile have remained stationary or relapsed to a savage state. And accordingly it has been slowly enveloping the globe with a network of missions, which, in connection with advancing science, commerce, and diplomacy, already betokens the ultimate triumph of Christian civilization over heathen barbarism throughout the earth.

Classification of the Christian Evidences.—Much ingenuity has been exercised in digesting and arranging the evidences which have thus been accumulating during this exciting history, but the most common and serviceable classification is that by which they are divided as *external* and *internal*, with suitable subdivisions.

The external evidences are such as relate to the fact or existence of Christianity, rather than to its nature or system —the mere credentials of revelation as distinguished from its contents. They naturally distribute themselves into the following groups: 1, *Prophecies*, which have been fulfilled in the course of ancient empires, in the coming of Messiah, in the fortunes and fate of the Jews, and in the progress of the Christian Church; 2, *Miracles*, which were wrought by prophets and apostles in attestation of their divine commission as teachers, disclosed in the life and death of Christ, the Son of God, and confirmed by the supernatural success of Christianity in the first age; 3, *Historical Testimonies* to the authenticity and genuineness of the sacred writings, afforded not only by undesigned coincidences among them, but by contemporaneous heathen literature and by modern antiquarian research. Collections of the first kind of evidence may be found in the works of Newton and Keith; of the second, in those of Watson, Sherlock, Lesley, and Campbell in reply to Gibbon, Hume, and Paine; and of the third, in those of Lardner, Paley, Norton, Greenleaf, and Rawlinson.

The internal evidences are such as appear in Christianity itself, in the purport of the revelation which has been so miraculously attested. An argument for its divine excellence may be traced in all that distinguishes it from other mere human systems: 1, in its *doctrines*, transcending the highest philosophy, such as the existence, perfections, and policy of the Creator, the origin of the world, the scheme of redemption, the state and destiny of man; 2, in its *precepts*, surpassing the purest ethics, such as the Ten Commandments, the Sermon on the Mount, the counsels of the apostles; 3, in its *examples*, unapproached by worldly heroes, such as those of evangelists, saints, and martyrs, and, above all, the immaculate Jesus himself; 4, in its *effects*, not only upon the welfare of individuals, but upon the interests of society, as seen in works of charity and philanthropy, in the arts of peace, in humane laws and free institutions, and in the entire civilization which for centuries it has been unfolding. Specimens of such arguments may be found in the treatises of Jenyns and Warburton, of Archibald Alexander, Hopkins, and McIlvaine, and of Luthardt and Delitzsch.

Still further classes of evidence are of a mixed nature, partly external and partly internal, and serve to show the connection and consistency of Christianity with other facts and truths. They also may be indicated under several heads: 1, *Experimental* evidences, acquired by those who have personally tested in their own faith and practice the doctrines, precepts, and promises of the Gospel, and thus offer new and original testimony; 2, *Scientific* evidences, collected from the sciences which illustrate the existence and attributes of the Deity, and confirm the incidental allusions of Scripture to physical, mental, and moral phenomena; 3, *Philosophical* evidences, derived from right reason and large experience as to the probable existence of a Divine government, a future state, a supernatural revelation, and a scheme of redemption, such as are found in the Scriptures, and also from the view of religion and nature as but consistent parts of one system, having the same author. Examples of such high orders of evidence may be seen in the works of Locke, Browne, Butler, Paley, the Bridgewater Treatises, and the Bampton Lectures.

These various classes of evidence, when grouped together in one view, tend to produce a conviction which has been well likened by Bishop Butler to what is called the *effect* in architecture or other works of art. Examined separately, they may excite as little emotion as scattered stones upon a plain, but when combined, as they have been by this great architectonic genius, in one compact, cumulative argument, their resulting impression is like that of the same materials after they have been chiseled and fashioned into a magnificent building.

Logic of the Christian Evidences.—A far more important question than the mere classification of these evidences is that of their logical nature and value. Viewed from this point, they must ever take rank as the highest branch of applied logic, as well for the difficult problems which they involve as for the kinds of reasoning employed. And the practical bearing of the inquiry is shown by the fact that different apologists, in treating of the evidences, have more or less consciously exaggerated one class of them at the expense of the other, until, like a divided army wrangling in the face of an enemy, they have allowed infidels to involve both of them in doubt and suspicion. Of the two evidential schools which have thus taken opposite grounds, the one would render Christianity reasonable, the other present it as simply credible; the one would claim for it demonstrative evidence carrying full conviction, the other seek only probable evidence accumulating toward certainty; the one would dwell upon the internal philosophical proof, the other upon the external historical testimony; and at length the one ends in testing the whole content of revelation by mere reason, while the other virtually destroys all rational conditions of faith. The former method has been successively pursued to its extreme by Descartes, Clarke, and Wolf, and the latter by Butler, Chalmers, and Mansel.

It is enough here to assert the validity of both methods within the limits they impose upon each other. Each has had its value at different times and for different minds. The primitive apologists needed the external evidence for the Jews, who required a sign, as well as the internal evidence for the Greeks, who sought wisdom. And from that day till the present there have been infidels who were won by the doctrine and example of Jesus before they could admit his miracles, as there have been believers who ceased to find difficulties in Scripture after they had accepted it as an attested revelation. The simple truth is that neither kind of proof can be spared from the high argument, and that both must be combined in order to insure full conviction.

At this point the logical question considered begins to involve an ethical or moral element. It should be carefully observed that the apparent deficiency in the Christian evidences neither necessitates unbelief nor releases from obligation. On the contrary, the inquirer simply becomes accountable in proportion to the evidence perceived and the interests at stake. He is still to be tested and judged by the light which he has. Moreover, his incredulity may be his own fault. It is certain that the Christian evidences have hitherto proved sufficient for the greatest minds of the race.

Progress of the Christian Evidences.—A distinguished mathematician of the seventeenth century, John Craig, professed to calculate, on the hypothesis that the suspicions against historical evidence increase with the square of the time, that the evidence of Christianity will become extinct about the year 3150, when the Son of Man will come and no longer find faith on the earth. And a school of modern skeptics, including poets as well as philosophers, is already sighing over the decay of Christianity as but the last of the world's mythologies, destined to be superseded by the perfect religion of the future. If all that is meant by such writers is the decay of their own Christian faith, it need not be denied that many restless, speculative minds are breaking away from their moorings in false creeds and corrupt systems claiming to be Christian; but if the apprehension is that Christianity itself is dying out or losing its hold upon the world, such forebodings are to be no more seriously treated than the outcries of men losing their anchorage who fancy it is the immovable shore and not their own little vessel that is drifting away. Christianity has in fact lost nothing of the evidence which it has been accumulating since the time when first its miracles were wrought and its prophecies spoken. Not only does the testimony to those miracles remain unimpeached, not only is the fulfillment of those prophecies still going on, but the human sciences since then unfolded are yielding it a new class of evidences, affording it fresh confirmation and illustration, and commending it to the highest intellect and culture of the time; and the reasonable presumption is that, one after another, they will yet corroborate all revealed facts and doctrines, until everywhere there shall be an intelligible triumph of the Divine through the human reason over all earthly error and sin.

That such an increase of evidence in this quarter is probable may be argued from the very nature of science and revelation as complementary factors of knowledge. It is inconceivable that the word of God should contradict his works, or that human reason could supersede a divine revelation; and when any discrepancies appear between nature and Scripture, we must simply assume that there has been some wrong induction from either or both of them, and that ultimately, after the whole truth is known, they will confirm and illustrate each other. This has, in fact, been the result of past conflicts between the scientific and religious parties. Geography, in the early Church, repudiated the idea of an inhabited globe as contrary to the Scriptures, but ships now carry the same Scriptures to the antipodes. Astronomy, during the Middle Ages, described the heavens as huge crystal spheres revolving about our earth, but the very same heavens, as devoutly interpreted by Kepler, Newton, and Herschel, still declare the glory of God. Geology has seemed inconsistent with the long-received interpretation of Genesis, but the story of the earth itself, as read by Miller, Hitchcock, and Guyot, still tells how it was made in six days. Anthropology is full of conflicting theories, some of which menace the Scripture doctrine of the first Adam, but he must simply prejudge the whole question against all precedent who asserts that man was not made in the image of God. And in the region of the mental, moral, and social sciences, where the need and fact of a revelation are so much more obvious, the likelihood increases that there will hereafter be still higher and grander illustrations of Christian doctrine.

It is an encouraging sign of progress in the evidences of Christianity that so many organized efforts are on foot for their promotion, and some of them in the interest of true science as well as of religion. The Royal Society itself was founded by philosophers and divines who vindicated the consistency of natural with supernatural knowledge. Other institutions have followed, expressly designed for the defense of the Christian religion, such as the Boyle Lectures, the Bampton Lectures, the Bridgewater Treatises, the Burnet Essays in Great Britain, and the Lowell, Graham, and Ely Lectures in the U. S., together with more permanent educational appliances, such as chairs of Christian apologetics in divinity schools and of science and religion in our colleges. And the literature which has grown up in connection with these institutions, and by other independent efforts, is already of surprising extent and richness. Notices of this literature may be found in the appendix to Farrar's *Critical History of Free Thought*, and the Abbé Migne has published a series of twenty volumes, 4to, entitled *Demonstrations Evangéliques*, containing a full collection of the principal evidential treatises, of all schools in all ages, chronologically arranged. CHARLES W. SHIELDS.

Evil: the total or partial absence or negation of good, and the presence of imperfection, suffering, or sin. The question of the origin of evil has in every age attracted the attention of thoughtful minds. The Zoroastrians and Gnostics tried to solve it by the dualistic theory of the opposition of a good and an evil principle. Others have maintained that evil is a necessary part of the Divine economy, and that under the superintendence of Infinite Wisdom evil will result in the highest possible good. It seems certain that moral freedom itself implies at least the possibility of an evil choice, so that evil must potentially exist where goodness exists. See PESSIMISM.

Evil Eye: the mysterious power of injury which in former ages was generally ascribed to the look of a malevolent person. The Greek and Roman classics contain numerous references to this belief, which was also very common in the Middle Ages in Europe. In Mohammedan and uncivilized countries this superstition is still almost universal, and it is by no means extinct among the peasantry of more civilized lands. It especially prevails in Western Africa. It is perhaps based upon the supposed powers of fascination possessed by serpents, of which much exaggerated stories were told and believed. Charms were much worn to prevent the mischief which it was believed could be done by the evil eye, which was considered especially dangerous to young children.

Ev′olute (see EVOLUTION): in mathematics, a curve, plane or otherwise, around which, if a flexible and inextensible string be wrapped, and then unwrapped under tension, there result other parallel curves called *involutes*, one of which is described by every point of the tense string in unwinding. Every plane curve has its plane evolute, besides an infinite number of helical evolutes lying in the curved surface of the solid generated by the motion of the given plane curve parallel to itself. The common cycloid, the epicycloids, and the hypocycloids have plane evolutes exactly similar to themselves, but inverted in position. The logarithmic spiral is the only curve having all its evolutes similar to itself.

Evolution [from Lat. *evol′vere, evolutum*, unroll, open up]: the act of unfolding, development; in algebra and arithmetic, the extraction of roots; in other words, the inverse operation to involution. The object of evolution, therefore, is to ascertain the quantity which multiplied by itself a stated number of times yields a given result. In a wider sense, evolution may be regarded as synonymous with the solution of a binomial equation, for it is obvious that the n^{th} root of any number a satisfies or is a root of the equation $x^n - a = 0$. This root is indicated by the symbol $\sqrt[n]{a}$ or $a^{\frac{1}{n}}$.

Evolution: primarily, an unrolling or an unfolding; so with respect to the living world it was used to designate the growth of the germ within the egg, under the belief that the organism existed there fully formed and that incubation was but the increase in size and unfolding of the minute germ. Later, the term ontogeny has been used for the development of the egg into the adult, while the term evolution has been restricted, in biological language, to denoting that continuous progress from the simple to the complex, from the homogeneous to the heterogeneous, which, in the judgment of naturalists, has been the method of origin of the varied animals and plants which now exist or which have existed. In the limited space available here only the barest outline of this organic evolution can be attempted.

The world is occupied by an enormous number of animals and plants—hundreds of thousands of species, myriads of individuals. Further, there are found in the rocks—those records of past ages—an almost equally great assemblage of forms, some of which are closely similar to living species, while others are greatly different from anything in the same region or even in the world. Further, all these forms, both living and extinct, show a wonderful range of adaptations to their functions and surroundings, and like adaptation of parts to the purposes they have to perform. The question for solution is this: How did all these forms come into existence? for the evidence is ample that there was a beginning. Several answers have been attempted, only two of which obtain much acceptance. The one predicates the existence of an Omnipotent Being who created them as we find them; the other does not deal with the question of the origin of life, but claims that given one or a few original forms of life all other forms must have come from them by the accumulative effects of innumerable small variations correlated with the action of heredity. This latter is the theory of organic evolution, a theory which has given rise to an enormous literature, and which is accepted by every naturalist the world over, with the exception of a very few who were already old men when, in 1859, Darwin first placed the idea before the world in a systematic form. The questions under discussion are merely those of detail; and in every investigation the law of descent is made the touchstone of the truth or falsity of each and every discovery.

The three great factors of evolution are (1) variation, (2) heredity, (3) struggle for existence, with survival of the fittest.

Variation.—According to the one idea species are immutable. There is, indeed, variation, but the extent of variation is always limited by specific boundaries. The great difficulty at this point comes in the definition of a species. Linnæus, who is frequently regarded as the father of zoölogy, said: *Tot sunt species quot ab initio creavit infinitum Ens* (There are as many species as an infinite being created at the beginning)—a test which is absolutely incapable of scientific application—while the older Agassiz, writing at the very time when Darwin was bringing out his epoch-making volume, *The Origin of Species*, maintained that species were actual things, capable of almost mathematical valuation and definition. However, the various tests for species have proved weak and faulty, that of the fertility of hybrids having no more value than other supposed tests. As a rule, crosses between what are regarded as distinct species prove infertile, but frequently these hybrids can reproduce their kind. On the other hand, according to the anti-evolutionist's view, descendants from a common ancestor must belong to the same species, and yet the rabbits of Porto Santo (descendants from the European stock of nearly 500 years ago) will no longer breed with their continental cousins. In short, there is no test for species, specific lines are as intangible as those between heat and cold, and the very idea of a species is a concept of the human brain without a corresponding object in nature.

The existence of variation is indisputable. The children of the same parent almost always differ in features as well as in mental characteristics; the leaves upon the same tree vary in size, shape, venation, and color. A clear realization of the nature and extent of this divergence is necessary for appreciation of the theory of evolution. Those variations which occur in domesticated forms are most widely known, and one has but to recall the thousands of varieties of apples, which vary in every conceivable character, and the varieties of cattle (Jerseys, Alderneys, Holsteins, muleys, Durhams), and of the barnyard fowl, to see something of the range of variation which can take place in a few years without excessive change of conditions. Possibly most striking of all are the differences between the different breeds of domesticated pigeons, all of which are descended from the common rock pigeon (*Columba livia*) of Europe. In the wild state this bird is a slaty blue, with a dark band across the end of the tail, two black cross bands on the wings, while the tail feathers, as in all wild pigeons, are twelve in number. From this type, by cumulative variation, have descended all the many recognized breeds, in which scarcely a feature has been left unaltered. Some are pure white, others pure black; the pouters have developed an expansible crop, the fantails have increased the tail feathers in some cases to forty, the tumblers have adopted the strange habit of turning back-somersaults, while the short-faced tumblers have shortened the skull, and the carriers have lengthened it. Thus every portion of the body is capable of variation, and in every direction.

It may be said that domesticated animals and plants are living under abnormal conditions; but the same variation, differing only in degree, is noticeable everywhere in nature, and from the standpoint of the evolutionist it would be as prominent there were it not for the principle of panmixia, to be mentioned below. Variation is seen everywhere, and a little careful study will show that its extent is far greater than is ordinarily supposed. Thus the studies of Dr. Joel A. Allen on the birds of the Eastern U. S. have often been quoted. He shows that in a large series belonging to the same "species" the variation will amount to from 15 to 20 per cent.; and further, that every part of the bird varies with regard to the others. Thus the feathers of wing and tail will vary among themselves, giving these organs different contours; the colors and color patterns will change to such an extent that had one only the extremes of the series there would be no hesitation in classing them as distinct species. Habits are constantly changing. The nests of many birds are far different now from what they were years ago; but possibly the most striking instance is the change in diet of the kea-parrot of Australia. This formerly fed on insects and honey. Since the advent of the whites it has become carnivorous, and it will now attack living sheep, burrowing great holes into the backs of these animals.

Variations in mental characters are less evident in wild animals because of the difficulty of observation, yet every one has noticed the variations in timidity, the differences in intelligence, presented by individuals belonging to the same brood.

Several causes of variation have been described, but all are not of equal importance. All, however, are alike in that they can admit of no limit to the extent to which variation can proceed in successive generations.

First come mechanical causes. Use and disuse of parts may produce variations in a manner easily understood. Thus the blacksmith by continual use of his arm increases its size to far beyond the normal. Pickpockets are said, by continual pulling at the index finger, to make it equal the second finger in length, a matter of no slight importance to them. The German soldiers, by frequent and prolonged drilling, induce the formation of a bone in the skin of the hand (*Exercierknochen*) where it comes in contact with the lock of the gun. On the other hand, disuse of a part causes a deterioration in size and in functional capacity. The leg, enveloped in a plaster bandage, shrinks in size, and this merely from disuse, not from any compression of the nourishing blood-vessels. The Stylites of religious fanaticism completely lost the use of certain members.

Closely allied to variation by use or disuse is the modification by change of function so strongly insisted upon by Cope and Spencer as a factor in evolution.

That these mechanical causes can produce modification of structure is beyond dispute, but the part that such modifications play in the evolution of new forms is still in dispute. According to Lamarck and to the Neo-Lamarckians, as they call themselves, variations acquired in this manner are all-important, because liable to become hereditary. The other school, the Neo-Darwinians, deny that they are to be considered at all. (See *infra*, and also the article HEREDITY.)

There is also a marked connection between the environment and variation, but whether environment stands in a causal relation is not certain. Possibly as striking an instance as any is that described by Schmankewitsch. He found that a certain Phyllopod Crustacean (*Artemia salina*), occurring in the brine of the salt vats of Southern Russia, when the brine was weakened produced a distinct species (*Artemia mülhauseni*). He went further, and by gradually freshening the water the changes became more marked, and when it was quite fresh, after several generations, the antennæ had altered their form, a joint had been lost from the abdomen, and other changes had occurred of so great an extent that a distinct genus—*Branchipus*—had been evolved. Here also are to be noticed the observations made by Dr. Joel A. Allen on the relations between climate and color. This student finds that in the same species of North American birds and mammals, as one goes from north to south, or from a dry climate to a humid one, the colors become more intense; and further, that the alterations in color are correlated with variations in absolute size and in the relative proportions of parts. It is, however, possible to explain these and other similar cases without considering them as the *direct* result of the action of the environment upon the organism.

Were all variation induced by external causes, like those already indicated, it would in all cases show a more or less evident adaptive character. One finds, however, numerous instances where there is, so far as can be seen, no relation between the variation and the surrounding conditions. Such, for instance, are the variations in the individuals of the same brood, or from the same lot of seeds. Hence one may distinguish sharply between two classes of variation: (1) those produced by the operation of external agencies, which Weismann calls acquired characters; and (2) those the causes of which are to be sought within the organism itself. These latter—congenital variations—proceed from alterations in the germ-cells themselves. How these modifications are produced is not certain. (See HEREDITY.) The most plausible theory is that which connects them with the modifications and diminutions which the germinal substance undergoes in its maturation, and then the union of these modified and diminished germs.

In this field of the causes of variation the most suggestive discoveries may be expected. The important point is that variations occur, and that they may appear in all portions of the organism, and may have any conceivable direction.

Heredity.—The second factor of organic evolution is heredity. By this word is meant not only that law of nature whereby individual peculiarities may be repeated in a second generation, but that principle which insures perpetuity, which is expressed by the breeder as "like begets like." We notice the reappearance of individual peculiarities by inheritance—that a six-toed cat will have six-toed kittens—but one is apt to lose sight of that more wonderful fact, that a cat will invariably have kittens, not puppies or whales. Of the universality of this law none can doubt. "Blood will tell" is but a homely expression of it. In some way the parent is able to impress upon the germ-cell the capacity of reproducing not only the broader features of class and genus and species, but not infrequently the more subtle characters of the individual as well. To explain this capacity, which is common to both animals and plants, various hypotheses have been advanced (some of which are outlined in the article HEREDITY), but they need not be detailed here.

Variation and heredity are contrasting factors. Variation is constantly introducing change. Heredity as constantly tends to reproduce the old conditions. Variation introduces new features, new modifications, into each succeeding generation; heredity strives to perpetuate the generation that has gone before. Variation is progressive; heredity conservative.

As was hinted above, it is not yet certain whether all variations can be perpetuated by heredity, and according to the view taken, two schools of modern evolutionists may be differentiated. The one, the followers of Weismann—Neo-Darwinians, they are called—claim that there is no satisfactory evidence that those variations which are the result of mechanical causes (in other words, acquired variations) can be inherited; that every instance in which the effects of use and disuse, of mutilations, of prenatal influences, and the like are supposed to be shown, are capable of explanation upon another basis. The other school—that of the Neo-Lamarckians, which has its stronghold in the U. S.—maintains, on the other hand, that "acquired variations" can be transmitted from generation to generation, and that since these variations are and must be adapted to external agencies and surroundings, and hence of greater value to the individual and the race, it must needs follow that such variations are most important in the differentiation of new forms of life.

As will be seen, the line between the two views is sharply drawn, and time must elapse before the dispute is settled. The idea of the inheritance of acquired characters is the old one, and indeed it forms the whole of the evolution of Lamarck. The view of Weismann is new, but it accords so well with what is known of the constitution and phenomena of the germ-cells that it has been most favorably regarded by the majority of the embryological workers. Weismann has provided a logical theory of heredity, in good accord with what is known of the egg and sperm cells, through which inheritance must take place, and in this theory there seems no place for the transmission of acquired characters. How the dispute will end can not be predicted. It must, however, be kept in mind that the differences between the schools are upon methods; both agree that variations exist, and that some variations at least can be transmitted from generation to generation.

Heredity furnishes some other interesting phenomena which have a bearing upon evolution. One of these is reversion. This is the reappearance in the progeny of characters or traits not seen in the immediate ancestors, but which are found in those more remote. Sometimes but a single generation is skipped, at others the number of generations omitted is enormous. When pigeons are removed from the somewhat abnormal conditions under which they exist in domestication, they exhibit a marked tendency in successive generations to revert more or less perfectly to the rock pigeon, or ancestral condition. In other cases the reversion is more marked and more remarkable. Evolution teaches that the single-toed horse has descended from the three and four toed horses of the Eocene age. Hundreds of thousands of years have elapsed since the three-toed condition was normal, and yet among modern horses polydactyle individuals occasionally occur, and this three or four toed condition must be regarded as reversional or atavistic in character. Cope has pointed out that in man the teeth of the higher races are tending back toward those of the lemurs, a reversion which is not occasional, but which is becoming the normal condition. In all cases of reversion or atavism, the more recent the change the greater are the chances of the occasional reappearance of the ancestral condition.

Another feature of heredity is the constant tendency toward reduction to the average by the action of the law which Weismann has called panmixia (or cessation of selection). A supposititious case will illustrate this: Suppose an animal appears with a neck much longer than the average in the species. It pairs with another with a normal neck. Now, other things being equal, the chances are decidedly against the reappearance of a neck of the same length in the second generation. On the contrary, it may safely be predicted that, unless some selection be active, the necks of the descendants will, in a few generations, be reduced to the normal.

Struggle for Existence.—As one ordinarily looks upon nature, the idea of a constant struggle seems absurd. An occasional bird may fall a victim to a cat; a hawk may pounce upon a snake or field-mouse, but, as a whole, nature seems quiet and peaceful. A more careful examination, however, shows that this peace is but superficial; in reality every plant and every animal is in a constant struggle for existence. The struggle is constant, omnipresent, and its effects are correspondingly great. It is a logical result of the geometrical ratio of increase of all living things. Were the progeny of a single pair, no matter how small, or how slow breeding, to go on generation after generation reproducing their kind without any check except natural death, it would require but a short time for the whole world to become too small for their accommodation. Thus Darwin, taking the elephant (possibly the slowest breeder of all animals) concludes that in 750 years the living offspring of a single pair would number nearly 19,000,000. Supposing that each egg should produce an adult, in twenty-five years the descendants of a single pair of codfish would make a mass larger than the earth. In the lower forms the reproduction is even more rapid. Maupas states that were the infusorian which he studied—itself invisible to the naked eye—to continue at its most rapid rate of division for thirty-eight days, the result would be a mass of protoplasm equaling the sun in size.

So it is with every animal and every plant. Unchecked, they increase with enormous rapidity; and yet under normal conditions there is no such increase, but rather a balance of nature. The total number of individuals remains tolerably constant, and taking several years together the number of forms in a given area shows but little change. Indeed, the world is about as full of individuals of animals and plants as it can possibly be. Such being the case, and such the natural rate of increase, there must of necessity be a constant struggle for existence, a struggle which if not outwardly apparent is none the less real; a struggle between the various species and a struggle between the individuals of the same species as well.

In the well-kept garden the plants cultivated are to a large extent removed from this competition, but when the garden is neglected the struggle begins. Weeds spring up, and in a few years they have choked out the former vegetation, and even some of the first weeds to appear have themselves disappeared. In a forest of birches there is a struggle between the individuals. Each year myriads of seeds are produced, but of these only a sufficient number grow into trees to replace those which die. If now a single beech-tree spring up in the forest, the character of the struggle changes. No longer do the birch-trees have to compete with each other; they have to struggle with the new invader. It lies between beech and birch, and ultimately, except in favored localities, the birch must succumb. Among animals it is the same. Every species is limited in numbers by the question of food as well as by the abundance of forms for which it in turn forms flesh, to say nothing of questions of climate and the like.

Usually the factors which enter into this competition are very numerous and very complex. One of the simplest instances is this: The abundance of clover in any locality is directly dependent upon the number of cats and owls in the region. The capacity of clover for reseeding itself depends upon the fertilization of its flowers, and this fertilization is accomplished chiefly by bumble-bees. Now bumble-bees form the principal food of field-mice. Hence fewer cats and owls, more field-mice, fewer bees, less seed and less clover the next year. In most cases the factors are more complex, and it is a dangerous thing for man to attempt to alter the balance of nature. Witness the ill-advised introduction of the English sparrow into the U. S., and the disastrous importation of rabbits to Australia.

Now, if there be such a struggle, what is to determine which individuals and which species shall survive? Evidently the answer must be those individuals and those species which are best fitted for their environment. Hence as a corollary to the struggle for existence follows the principle which Spencer has termed "the survival of the fittest." By this it is not implied that in every instance the best will survive, the unfit will be killed off. Nature deals with enormous numbers, and it is the great majority of which we speak. In the production of varieties of domesticated animals and of cultivated plants the breeder and the horticulturist exercise a selective action. They choose for breeding purposes those individuals which present variations in the desired line, and in the second generation a similar selection is again exercised, until the result may be quite different from the form with which the start was made. Variation, an inheritance of variations, and an artificial or human selection have produced all of the most highly prized cultivated plants and domesticated animals; selection for speed has given us our trotting horse; selection for color, our wonderful displays of tulips; selection for fruit, our peaches, apples, etc.

These are cases of artificial selection in which human intelligence plays an important part. There is an analogous selection ever operative in nature—natural selection—which insures, in the long run, that those forms best fitted for their surroundings survive and alone perpetuate their kind. This principle was ignored by Lamarck; it was first recognized by Dr. W. C. Wells, of Charleston, S. C., who, in 1813, noticed that Negroes and mulattoes are exempt from certain tropical diseases, and argued that nature, like man, exercised selection, and thus originated varieties of human beings fitted for the country they inhabit. This principle, however, remained without further public notice until 1859, when Mr. Alfred Russel Wallace and Charles Robert Darwin read essays which again brought the principle before the scientific world, supported at this time by a weight of evidence that was perfectly overwhelming.

The struggle for existence is severe, and nature stands ready to seize upon and perpetuate the slightest variation which may be of advantage to the individual, and in consequence to the race. The slightest superiority in some one particular may prove the means of life; a correspondingly slight inferiority may result in death. This difference may proceed from a change in the organism, or from modifications in its environment, or from both. It has been seen that all living beings are liable to variation, while geology teaches that the "everlasting rocks" are far from stable and that our earth is in constant change. Elevations and depressions of its surface will convert marshes into dry plains, meadows into lakes; will change the directions of ocean currents, and alter the prevailing winds. These in turn will modify the temperature and humidity of large regions, thus changing the environment of the fauna and flora. Many forms can not adapt themselves to the new conditions and hence must become extinct, while those which show greater adaptability and greater modifications will be more apt to survive. Now, since such modifications are subject to perpetuation by heredity, the result must be the formation of a new race. It is not blind chance which determines the question of life and death; it is a fixed law so determinate in its character that when the factors are known the result can with certainty be predicted.

For instance, a terrestrial animal inhabiting a marshy country is the better adapted for its surroundings when it has a broad and spreading foot which prevents it from sinking in the mire. When the region is drained, the large foot is no longer an advantage, rather an incumbrance; and, other things being equal, those species and those individuals which show a tendency toward reduction in the size of the foot will have the advantage. This is no fancy sketch. It is one which long ago was pointed out in the history of the horse. On the other hand, the struggle is not always be-between the individual and climate, etc.; it may occur between species and between individuals of the same species; or, again, the alterations produced in one animal or plant may affect its neighbors. In fact, the play of interactions is wonderfully complex. Here, too, must be mentioned that other struggle which Roux has termed the battle of the parts within the organism, the meaning of which is self-explanatory.

Every investigation goes to support the view that there is an intimate interdependence between organisms, and that probably every character which appears in the living world is or has been of distinct advantage to the race. For years no other reason was suggested for the bright colors and attractive perfumes of flowers than that they were intended for the gratification of the æsthetic tastes of man. Now it is known that this is not their end; they exist rather as attractions for insects, etc., on which depends pollination and production of seed. Every advance in knowledge clears up previous difficulties, and either shows a utilitarian adaptation in every feature or demonstrates that the organ in question is a remnant of some structure which formerly has been of use but which is now on the road to obsolescence. To this latter category belong such structures as the vermiform appendix of the human intestine. Except in the light of evolution it is absolutely inexplicable in the human being, for it subserves no function, but is a veritable death-trap. In the lower vertebrates the same organ is large, and clearly has there a digestive function. In man it is a vestigial structure derived from the ancestor and retained in its degenerate condition through the conservative action of heredity. In short, the old doctrine of final causes has had to shift its base; the new teleology accommodates itself to evolution.

To summarize the foregoing: All animals and all plants are constantly varying, and these variations may have every conceivable tendency, some being distinctly beneficial, others as distinctly injurious to the forms in which they occur. Every individual, from the moment it begins life, even while an egg, a seed, or a spore, is a partaker in an active struggle for existence; and while accident may occasionally produce a different result, those species and those individuals which are best fitted by variation for their part in the world will survive. The principle of heredity now steps in and insures the repetition of the favorable variation in the next generation, where it may serve as the basis for new variations, which in turn will undergo similar selective processes. As a logical result of these factors a sufficient length of time is alone necessary to people the earth with all its present varied fauna and flora from a single primitive type of life. Further, the apparent gaps between so-called species are but the tombstones of the unfit or less fit which have fallen by the wayside.

Proofs of Evolution.—There are two records of the history of the living world, both of which have been carefully studied, and both of which are well understood. One is embryological, the other geological, and both are in full accord with evolution.

Geology teaches that what are known as stratified rocks have been laid down as deposits at the bottom of bodies of water. Hence objects which are included in them are of the same age as the deposits themselves, while of two layers or strata the lower is the older. Hence by studying these rocks and their included fossils a clear history may be obtained of the main features of the world of life which has gone before. Were the series of rocks continuous and complete, and were all forms which have lived preserved as fossils, the testimony of geology upon the question of evolution would be absolute. Unfortunately this is not the case. There are many breaks in the series of rocks where whole ages have left no trace; and, on the other hand, there exist large numbers of forms of life, of great importance from the standpoint of the evolutionist, which have no hard parts capable of fossilization. Such being the case at present, it is inferred that such was the case in the past. Hence the geological record is faulty* in two respects; but even if faulty it should, so far as it goes (provided evolution be true), agree with the doctrine of descent. Thus we ought to find in the successive strata constant progress in life from the simple to the complex, and that the older forms should be lower and more generalized. Even with the imperfect records there ought to be found direct evidence of the transformation of one species into another, and conclusive proof that from one species two or more distinct species have been evolved.

At the very bottom of the stratified rocks are some which contain no recognizable fossils, but they show evidence of

* Darwin spoke of this imperfection of the geological record. The anti-evolutionists of 1860 made reply that the bulk of the world is already known, and that no important geological discoveries were yet to be made. Ten years later began those wonderful investigations in the Western U. S. which have revealed more than three times as many mammals as were previously known. So, too, wonderful discoveries have since been made in India, South Africa, Greece, Australia, and the Argentine Republic. And yet Africa, Asia, and Australia are unknown. Further, every new palæontological discovery has readily fallen into its proper position in the doctrine of descent; not a single fact has come to light which tends to discredit it.

alteration by intense heat, and contain graphite—a highly metamorphosed coal—which may be of vegetable and, possibly in some instances, of animal origin. In the Cambrian are found numerous forms of life, but all are extremely generalized. In the Cambrian are found generalized sharks, the lowest vertebrates possessing hard structures. In the Carboniferous the batrachians appear; the reptiles are first known in the Permian, and reach their culmination in the Cretaceous; while mammals appear as monotremes or marsupials in the Triassic, and then, after an as yet inexplicable absence from the Cretaceous, reappear in higher and more differentiated species in the Tertiaries. The birds make their appearance in the Cretaceous. Thus there is in the order of appearance exactly the same progress from the simple to the complex, from the undifferentiated to the specialized, which evolution demands.

The geological record is more detailed than this. It is possible to trace clearly, step by step, the evolution of a large number of forms. The history of the rhinoceroses, the horses, and the crocodiles is known in detail. In the successive beds can be traced the gradual modifications of the skeleton of *Prohatteria* of the Permian, which resulted in the gavials, alligators, and crocodiles. All the stages can be found which intervene between the four-toed *Eohippus* of the Lower Eocene and the three-toed *Anchitherium* (*Miohippus*) of the Miocene to the single-toed *Pliohippus* of the Pliocene and the horse and zebra. Not only the successive steps in the evolution of foot-structure are preserved, but also every phase in the development of the complicated enamel pattern of the teeth.

Neumayr and Paul have studied the fossil fresh-water shells of an old lake basin in Hungary, and Hyatt has performed a similar service for corresponding beds in Würtemberg. In both localities the successive layers afford slightly varying forms, so that in either bed can be seen the gradual evolution of the new species and the extinction of the old. In some cases the causes of extinction can be seen, and the character of the unfitness demonstrated. With this slight reference the geological record must be dismissed.

A little more detail may be pardoned in stating the character of the embryological record, since this has not so thoroughly found its way into the popular works. If the principle of heredity be true, one would expect to find in the development of animals and plants traces of the line of descent. If evolution be true, one ought to find, following back the development of the egg, just as in the geological record, that specific details would vanish and give rise to more generalized features; that the earlier the stages the more the embryos of related forms would resemble each other.

The lowest forms of animal life are the Protozoa, each individual of which is but a simple mass of protoplasm with a central differentiated spot, the nucleus. In the language of histology it is a simple cell. The egg of a frog, for instance, can be described with the same language. In other words, the egg is the representation of the protozoan stage. The protozoan can reproduce itself by dividing into two individuals, each with its nucleus. The frog's egg in its development segments in a similar way, with the same wonderful processes. In certain very low forms (*Volvox*), sometimes classed as animals, sometimes as plants, the organism consists of a hollow sphere of cells produced by the continued division of a protozoan-like germ. In the developing egg of the frog a corresponding stage with central cavity and superficial cells occurs.

In the plane above the Protozoa comes the great group of Cœlenterates, in which the body has but a single opening, connecting the external world with a two-walled sac. This opening serves at once for mouth and vent, while the internal sac serves as stomach. In the next stage of the frog's egg one side of the hollow sphere becomes pushed in, much as one might push in one side of a rubber ball, thus converting it into a double sac like the Cœlenterate. The resemblance goes further. The inner sac becomes the stomach, while the opening is converted into the vent of the adult. In the Cœlenterate the nervous system is but a portion of the outer skin, and all the sense organs are differentiations of that layer. In the frog's embryo there is a stage when the brain and sense organs—eyes, ears, and nose—are differentiated from the outer layer of the sac.

Next, the frog's egg passes through what may be called the annelid stage. On either side of the body are formed little blocks of muscle which correspond to the segments (rings) of the earthworm, for every vertebrate is as plainly made up of a series of segments as is any worm or arthropod. A central circulatory apparatus forms, in both frog and worm, on the side of the intestine opposite the nervous system, and further, in both, branches run from this central tube between the blocks of muscle. Some of these in the frog, as in the fish and shark, form the gill arteries, and they unite above in these forms, as in the earthworm, to form a dorsal aorta.

In the following stage the developing frog leaves the invertebrate behind, and takes on true vertebrate features. The mouth becomes open, as in the shark, while the gill-slits are formed, from which gill filaments soon protrude. Somewhat earlier, in both frog and shark, the digestive tract forms a cartilaginous rod on its dorsal surface (the notochord), about which the vertebræ later appear. In the frog can be seen a shark-like stage in the development of the skull—the same formation of cartilage rods and sense capsules, the same formation of a cartilaginous case for the brain. Here the frog leaves the shark behind, and developing true bone, a complicated skeleton for the limbs, lungs for respiratory purposes, becomes a true frog.

The foregoing is but one of thousands of series of correspondences which every naturalist can furnish, in each case there being the closest parallel between the geological and embryological records, and in both there is the same sequence, the same conditions which the theory of evolution demands. A few coincidences might be explained as accidental, but they are so numerous, so universal, that one is fully warranted in the aphorism that the history of the individual (i. e. embryology) is a recapitulation of that of the race. So firmly has this principle been established that it is used as the chief factor in tracing relationships and pedigrees of both animals and plants, especially in those groups where there are no hard parts for preservation as fossils, and where, consequently, the geological record can not be consulted.

There is also much corroborative evidence of varying character. Here is to be enumerated the evidence of atavism or reversion already referred to. The occasional occurrence of well-defined and regular banding on horses indicates a former zebra-like ancestor, while the occasional occurrence of three-toed horses points clearly to the three-toed progenitor of the Eocene.

Here, too, one must refer to the geographical distribution of both plants and animals. Those forms which, both from embryology and geology, are known to be extremely old have a very wide range, and at the same time are poor in species. Thus the scorpions, dating from the Silurian, are found, with slight variations in form, in all quarters of the globe. The horseshoe crab, which has existed in a scarcely modified condition since the Carboniferous, is found in both the Atlantic and Pacific Oceans. Phyllopods, which appear in the Cambrian, are found all over the world to-day. The primitive Dipnoi, or lungfishes, with but four living species, range from South America to Africa and Australia, and one genus (*Ceratodus*) has existed since the Triassic. *Lingula*, a brachiopod which occurs in the Cambrian rocks, is found in the seas of the Carolinas and of Japan. The marsupials, already referred to as among the oldest of mammals, are living in America and Australia. In all of these, and hundreds of other instances, these old forms are found widely separated and few in species. When, however, one studies the fossils, he finds them distributed through all the intervening regions, and is forced to the conclusion that the existing representatives of these groups are the survivors of a formerly widely distributed fauna and flora which is all but extinct.

Coming to the newer forms, one finds that there is a close connection between the past and present fauna and flora of certain regions; that these newer forms have their centers of origin, and have not yet become distributed far from it. Thus South America was the former home of the edentate mammals, and in the same region flourish the sloths and armadillos of the present epoch. In Australia all the mammals* at the time of the discovery belonged either to the monotremes or marsupials. In the same island continent is found a rich fossil fauna, but not a single representative of the placental mammals. The conclusion is that since this region was first peopled by the then existing highest mammalia, it has been protected from immigration of the higher groups which have arisen in other parts of the world. On the other hand, evolution has not been idle here, for in Australia the marsupials have evolved a range of

*** Excepting the dingo, or native dog, probably introduced by man.**

forms which strikingly imitates, in all but method of reproduction, the forms which have arisen in other parts of the world. One needs but to mention the strange kangaroos, the rodent-like wombat, the cat-like dasyures, the insect-eating bandicoots, and the sugar squirrels, so like the flying squirrels of North America, resembling in general habits and many points of structure the forms they have been compared with, and yet all bound together by the pouch for the reception of the immature young.

The Evolution of Man.—If the theory of evolution be true, man, like all other living forms, must be the result of its laws. He must show variation and heredity, and, like all other organisms, must be subject to the law of survival of the fittest. Further, there should be in both geology and embryology undisputable traces of his past history.

In the embryonic history of man there are certain peculiarities which, upon the idea of special creation, are perfectly inexplicable; in the light of evolution they are exactly what one ought to expect. The egg of man, in its earlier phases, passes through stages which are capable of exact comparison with those of the frog, described above. The egg divides, forms the germ layers, nervous system, notochord, and muscle plates in exactly the same way. Then comes the same formation of heart and blood-vessels. In man, as in the fish, the heart is at first two-chambered; then it becomes three-chambered, as in the lower reptiles; and later it develops the four-chambered condition, which it retains through life. In the blood-vessels are the same gill arteries as in the frog or shark, running in the same direction and uniting to form the same dorsal aorta. There is the same tendency to form gill-slits upon the sides of the neck, and in exactly the same manner, as outgrowths from the throat toward the external skin. Later the blood-vessels change, the gill-slits close up, all except the first, which persists as the Eustachian tube, connecting the throat with the middle ear.

After a time the distinctively mammalian features become more prominent, and there comes a time when no one can decide between two embryos which is that of a dog and which that of man. Later the two can be distinguished, but still that of man and that of a monkey show no differences, that of man presents so many monkey-like features. A few of the monkey-like characters of the human embryo may be suggestive. At one stage there is a true tail extending considerably beyond the legs and containing several more vertebræ than can be traced in the coccyx of the adult. The convolutions of the brain at the seventh month almost exactly parallel those of the baboon, and the great toe, instead of being longer than and parallel to the others, is shorter and extends at right angles to the axis of the foot, just as it does in the foot of monkey or ape. At the seventh month the whole body, except the palms of the hands and soles of the feet, is, like that of the ape, covered with hair. Even after birth the monkey-like characters have not entirely disappeared. The young orang-utan clings with its hands to the hair on the mother's breast, and the newly born infant, so weak in other respects, will cling to any hairy surface with sufficient grip to support its weight.

In structure the differences between man and the nearest mammals are extremely slight. His superiority in the struggle for existence lies in the development of the intellect, and, transposed to this plane, the struggle is the same as before, differing only in degree. Excepting articulate speech and a spiritual nature there is nothing in man which can not be traced, less developed, in the brute creation. Every owner of a horse or dog knows that these animals possess intelligence, and have as clear ideas of right and wrong as have many human beings. Mr. Romanes has given us accounts of monkeys and higher apes which show that these animals, as would be expected from their nearer structural relationship to man, are far more intelligent than the horse or the dog, while no one who has read Sir John Lubbock's charming works can doubt that animals even so low as bees and ants, if not possessed of articulate speech, possess other means of communicating with each other.

It may be objected that man can form abstract ideas, while brutes can not. This is true of only the higher races of man, but of the lower to no greater extent than of many brutes. Many tribes have words for white stone, black stone, red stone, but none for stone; for elm-tree, oak-tree, and the like, but none for tree. Is it difficult to believe that a dog does not form as clear an abstract idea of tree as do these people? In short, the intellect must be regarded as subject to the same laws as the physical structure, and it must be concluded that those differences upon which such stress is laid are not those of kind, but of degree, while their extent presents no insuperable obstacle to evolution.

Man is varying and changing. His intellect has removed him from many consequences of the law of the survival of the (structurally) fittest and made him subject to another lot. He is consequently undergoing a structural degeneration at the same time that he is becoming more intellectual. Thus the teeth of the higher races are reverting to those of the lemurs, while the wisdom-tooth is on the road to entire disappearance. The eyes are becoming weaker and less perfect, the eighth rib is losing its connection with the sternum, the lower jaw is becoming smaller and its muscles weaker, while a joint is disappearing from the fifth toe. On the other hand, the skull is increasing in size and its sutures are disappearing in the adult. The muscles of the hand are undergoing differentiation and improvement, and the arms are changing more rapidly than the legs.

Man further possesses many structures of no possible present use, which can not be explained upon any hypothesis as yet advanced, except upon that of his descent (or ascent) from lower forms, where they are of distinct value. Here are to be enumerated the vermiform appendix, already alluded to, the rudimentary muscles to move the ear, those muscles in the skin which in lower animals serve to erect the hair, and which in man have no other function than to cause the "goose flesh" of fear or cold, the tonsils, the pineal organ, the pituitary body, and the like.

The geological evidence in regard to man is as yet extremely scanty, but such as exists is in full harmony with the theory. The skulls of Cro-magnon and the Neanderthal indicate an intelligence far below that of any existing races, while that of Table Mountain in California shows that one must go back at least as far as the Pliocene age to find the time when the ancestors of man and of the existing monkeys separated. The almost entire absence of traces of primitive man is paralleled by the great scarcity of fossils of the anthropoid apes. It is possibly to be explained by supposing with Sclater that his primitive home was in the lost continent "Lemuria," which may have once occupied the site of the Indian Ocean, or with Wallace, that it was in the tableland of Asia, the geology of which is not yet understood. When the wonderful discoveries made in the Western U. S. are recalled one may be pardoned for believing that the future explorations in the cradle of the race may afford conclusive evidence of the descent of the human race, through the anthropoid apes, from the lemur-like forms, just as America has supplied the history connecting the Eohippus of the Eocene with the Equus of to-day.

Objections to the Theory of Evolution.—A theory so subversive of preconceived ideas as was that of evolution has naturally aroused no little antagonism, but it is a fact of great significance that as yet there has not been produced a single new argument against the theory. On the other hand, many of the so-called objections have been shown to be without force, and indeed in many instances to be strong supports of the theory. As a result the whole scientific world has accepted evolution, and it is a serious task to attempt to find any real argument against it. A somewhat extensive reading of critiques, etc., reveals but one stock objection: that no one has yet seen one species change into another. The answer to the objection in its first form is easy. Given a satisfactory definition of a species, and every naturalist can show myriads of instances of the evolution of new forms. The trouble is the anti-evolutionist begs the whole question when he assumes that a species is something fixed and immutable, and at the same time claims that all forms which can be traced back to one parent must belong to the same species. The other type of objection, the demand that the transformation be shown of the highest alga into the lowest zoöphyte, would not be worth a moment's attention were it not advanced by persons whose names bear weight in other lines of thought. It does not admit of serious reply, as it betrays such ignorance of the theory as should prevent entrance into scientific discussion. It is in effect a demand that a person transform himself into his cousin, a procedure only to be expected in the case of Dr. Jekyll and Mr. Hyde. See the next article.

The literature of evolution has become enormous, and reference can be made to only a few of the works in English which deal with various phases of the subject. Darwin, *Origin of Species*; *Descent of Man*; *Variation of Animals and Plants under Domestication*; *Fertilization of Orchids*; *Different Forms of Flowers on Plants of the same*

Species. Brooks, *Heredity.* Conn, *Evolution of To-day.* Chambers, *Vestiges of Creation.* Cope, *Origin of the Fittest.* Eimer, *Organic Evolution.* Galton, *Theory of Heredity.* Geddes and Thompson, *Evolution of Sex.* Haeckel, *Natural History of Creation*; *Evolution of Man*; *Anthropogeny.* Heilprin, *Distribution of Animals.* Huxley, *Man's Place in Nature*; *Origin of Species.* Le Conte, *Evolution and Religious Thought.* Mivart, *Genesis of Species.* Müller, *Fertilization of Flowers.* Romanes, *Scientific Evidences of Organic Evolution*; *Animal Intelligence*; *Darwin* and *After Darwin.* Schmidt, *Descent and Darwinism.* Semper, *Animal Life as affected by Natural Conditions of Existence.* Spencer, *Principles of Biology*; *Factors of Organic Evolution.* Wallace, *Natural Selection*; *Darwinism*; *Geographical Distribution of Animals.* Weismann, *Studies in the Theory of Evolution*; *Heredity.* For the pre-Darwinian theories, see Butler, *Evolution, Old and New.*

J. S. Kingsley.

Evolution (as related to biological and geological questions): In the use of the term evolution it will always be necessary to discriminate between its different meanings. Literally, it is the act of unrolling; the primary idea being that of the unfolding of the leaves of a bud, hence the similar unfolding and extension of the germ in a seed, and the development of the embryo-cell of an egg into an animal. In a more general sense it is applied to any process by which a thing rudimentary or apparently homogeneous passes into a more heterogeneous condition in which it displays more or less complexity or distinction of parts or organs. We may for the present neglect, as exceptional, cases of retrograde development in which complex structures become more simple. In a hypothetical sense the term is applied to any supposed change or series of changes whereby organic and living bodies may pass from simple to more complex states, or whereby one species or kind of plant or animal may be transformed into another, usually of more complicated structure.

The present article is intended to refer more especially to the hypothetical employment of the term evolution in certain modern philosophical discussions, and will allude to the ordinary or matter-of-fact uses of it, chiefly in illustration of these, and in order to inquire what basis there may be in nature for the philosophical conceptions of evolution of organic beings held by Darwin and his followers.

There are certain data essential to this question which are not usually sufficiently considered, and which should therefore be stated in the first instance.

1. Evolution itself is not and can not be an efficient cause of anything. It is merely a development of things previously existing in embryo or potentiality, and is thus a process having its beginning and its stages, but dependent altogether on previous arrangements and on contemporaneous conditions or efficient causes. This is seen in the development of an egg. It must have an embryo-cell potentially representing the chick, and pabulum appropriate and available for its nourishment. To produce the evolution of these into a bird there must be the warmth of incubation. It would be absurd to expect by any process to hatch a bird from a pebble, and an egg kept in an ice-house would be equally incapable of development. In every case of evolution there must be (1) something to be evolved; (2) the development of this according to what may have been potentially in it; (3) the causes or conditions of the development. In other words, whenever anything is said to be evolved, three things must be considered: (1) potentiality, (2) development, (3) causation. Unfortunately there is too great a tendency to confine attention altogether to the second of these and to take the first and third for granted.

2. It follows from the previous statement that evolution, even if all the component parts above described are included in it, can not explain the origin of anything. It must presuppose something having at least potentially present all that is to be evolved. In other words, it has to take for granted all that is to be produced. It is certain that every feather of the chick must be potentially present in the embryo in the egg, and to explain the origin of this is therefore quite as difficult as to explain the origin of the complete bird. When therefore evolution pretends to explain origins it becomes a process of reasoning in a circle, and the question resolves itself into that old one, whether owls preceded eggs or eggs preceded owls. This is admitted in terms by Darwin and his followers, but they constantly overlook it. The title of Darwin's famous book *The Origin of Species* is an example. It really says nothing of the origin of species, but only of transmutations of species already in existence.

3. Taking for granted, as Darwin had to do, the existence of living organisms with all their powers and properties, and referring to their development with reference to cause and effect, four kinds of this may be recognized, to any of which may be given the name evolution, but they are quite distinct from each other. The first of these is the *direct* development of structures previously prepared and subjected to the operation of adequate causes, as heat, moisture, etc. Of this kind is the development of seeds and eggs into adult plants and animals. A second kind is *indirect* development, or that which takes place in adult organisms under the power and guidance of an external will. Such is the artificial production by men of varieties of plants and animals by processes of culture, selection, and isolation. A third kind would be a *fortuitous* or natural series of changes, by which varieties or even species might arise in nature, under the influence of external conditions. This has been termed variation under natural selection, but in this expression a fallacy is involved, unless an intelligent selector and varieties to be selected from are assumed, in which case it becomes the same with the second, except as carried on by some power distinct from man. A fourth kind which has been imagined, but is altogether unknown to science, is the *spontaneous* evolution of life and organization from that which is dead and unorganized. This, however, can not be realized in its causes and methods unless a creative power be assumed, and this acting in a way different from anything within the sphere of human observation.

These considerations, which do not seem liable to any doubt, closely restrict the sphere of organic evolution of the nature of phylogeny, or the development of new species from forms previously existing; and when we eliminate ordinary variation, in which varietal forms still capable of reproduction with each other and also capable of reversion to the original type are produced, it can scarcely be affirmed that there is any fact open to observation justifying the assertion that any case of the production of a distinct species in this way is known. Darwin's illustration taken from the domestic pigeon is a case in point. This bird, the original of which is believed to be the rock pigeon of Europe (*Columba livia*), has varied under domestication to such an extent that some of its breeds, if found wild, would be regarded as distinct specifically, or even generically, from each other. Yet all breed together freely, and all show reversion to the forms and colors of the wild stock. In this case also there is an indirect development dependent on human agency, and Darwin himself has ably proved that it could not occur in wild nature. This case, therefore, shows that the utmost efforts of artificial selection, acting for thousands of years on a creature easily domesticated and of plastic organization, have failed to develop a specific type. Obviously one is here at an infinite distance from any explanation of the origin of the rock pigeon itself, and there is no reason to believe that any treatment or lapse of time would suffice to separate it into distinct species.

Facts in support of the evolution of species being thus wanting, its advocates fall back on two kinds of evidence—(1) that of analogy between the evolution or ontogeny of the individual, and the phylogeny or evolution of the race; and (2) the succession of animals and plants in geological time. The first of these is liable to the objection, taken in the earlier part of this article, to the confounding of distinct kinds of evolution. It is not logical to establish an analogy between the evolution of a germ through various stages into an animal, whose parts were potentially present in the germ, and the evolution of an adult animal into an animal of another kind. Nor is it logical to allege an evolution taking place under special conditions of parental origin, incubation, etc., to prove the possibility of an evolution in regard to which all these preparatory conditions and efficient causes are absent. The only possible use of the argument from analogy is that suggested by Weismann, namely, that causes may so affect the germinal matter in an animal or a plant that the resulting germ to be developed shall not represent potentially the parent, but something else. This supposition accords with experience in the production of certain varietal forms, but is not known to produce new species, and if it could do this it would effectually overthrow the Darwinian idea of slow changes under natural selection, and the Lamarckian idea of similar slow changes under the influence of adaptation to environment. It would, in short, be a production of forms *per saltum*, and not by gradual evolution. The evidence of palæontology is equally unsatisfactory. It is not difficult to obtain, by selecting series out of the known fossil animals of successive periods, chains of forms which may be supposed to have produced each other; but the gaps are enormous in structure, in time, and in place, and there is no evidence of genetic connection, while the apparently abrupt and widespread introduction of new forms at certain periods of geological time, and their subsequent gradual decadence, seem to indicate the incoming of new dynasties of animals and plants in successive waves rather than by a gradual and imperceptible rise.

While the ordinary theories of evolution seem to be thus destitute of proof, there are certain arguments tending to show the imperfect and partial character of all the current doctrines of this kind, which merit careful consideration. (1) Current hypotheses of evolution are partial and imperfect in their tendency to refer numerous and complex phenomena to one cause or to few causes only, when all trustworthy analogy would indicate that they must result from many concurrent forces and determinations of force. This is especially evident when we consider the necessity of the co-existence of several distinct and unconnected things to produce the observed effect, and also the marvelous balance and correlation of the parts in the individual animal or plant, and the wide range of correlation of certain animals and plants with each other. The relations of nectaries in flowers and the suctorial organs of certain insects furnish a case in point. One must imagine flowers to develop useless and wasteful honey-glands or insects to part with their masticating organs to their own injury, or else imagine infinitely complex, simultaneous, yet independent, changes to occur in a manner altogether inconceivable. Asa Gray might well deny that insects could produce flowers, and he may have ventured too far when he admitted that they might perhaps modify them. (2) They are also partial and imperfect in their tendency to follow out supposed modifications of single organs without considering the correlations of these, and the balancing of parts which gives coherence to them as components in a complex whole. Nothing can more clearly indicate this than the delicacy and instability of constitution induced by breeders in the races of animals modified by artificial treatment and selection. Instances of this will occur to every one acquainted with domestic animals. (3) The ordinary theories of evolution are partial and imperfect in their tendency to think only of the continuous operation of physical forces and laws, and to leave out of sight the distinction between life and organization and dead matter, between mere force and the correlation and determination of forces, between the merely physical and material and the unseen and spiritual. This bald materialistic tendency is everywhere conspicuous, and seems almost to be essential to evolutionary speculations. (4) Such speculations are partial because they fall short of origins and final causes. They have to take for granted the existence either potentially or actually of all they propose to evolve, and this not in the mind and purpose of an eternal Creator, but in mere brute insensate matter. Even in assuming the existence of matter and energy they are begging the whole question of origins.

It is interesting to observe in all these respects the essentially unscientific character of evolution as ordinarily advocated, its violations of the inductive method, its tendency to assume that which has to be proved, and to found the structure of the universe on one speculative doctrine, and to pursue this in a vicious circle. In all these respects it has more affinity with those philosophical speculations which prevailed before the rise of experimental and inductive science, and its affinity in this respect is greatest with the least complete of these ancient systems. It has a nearer relationship to the atomism of Democritus than to the loftier idealism of Plato, while it seeks to string the whole of the precious gems of modern science on the slender and brittle thread of a specious but baseless speculation. Such philosophies have often dazzled the world. Originating with some powerful and persuasive mind, they have carried all before them for a time. Then, falling into the hands of feebler men, they have disintegrated into opposing schools and warring sects, which have destroyed one another. The Darwinian evolution, more short-lived than some of its predecessors, has already entered into this phase.

The diverse schools of evolution now contending with each other may perhaps be best considered in connection with the difficulties which have met the original Darwinian conception, and the various attempts to turn or overcome these which have led later speculators to diverge from the path of the great apostle of the creed.

One arises from the fact that most of the leading types can be traced so far back that they seem to constitute parallel rather than diverging lines, and show no certain evidence of branching. The continuance of the *Lingula* and other Brachiopods, and of the siliceous sponges and the Foraminifera, from the Cambrian to the modern, and more lately the history of the oysters, which have continued from the Carboniferous age to the present, and that of the scorpions, which have continued from the Silurian—in both cases with scarcely any more differences than their living successors present—may be taken as examples. With this must be connected the further fact that nearly all the early types of life seem very long ago to have reached stages so definite and fixed that they became apparently incapable of further development, constituting what have been called "terminal forms."*

A further difficulty arises from the failure to find satisfactory examples of the almost infinite alleged connecting links which must have occurred in a gradual development. This, it may be said, proceeds from the imperfection of the record; but when there are abundance of examples of the young and old of many fossil species, which can be traced through their ordinary embryonic development, why should not examples be found of the links which bound the species together? An additional difficulty is caused by the fact that in most types one finds a great number of kinds in their earlier geological history, and that they dwindle rather than increase as they go onward. This fact, established in so many cases as to constitute an actual law of palæontology, is altogether independent of the alleged "imperfection of the record."

Objections of this kind appear to be fatal to the Darwinian idea of slow modifications, proceeding throughout geological ages, and to throw us back on a doctrine of sudden appearance of new forms, occurring at certain portions of geological time rather than at others, and in the earlier history of animal and vegetable types rather than in their later history, and in early geological times rather than in those more recent. This doctrine, however, of critical or spasmodic evolution is essentially different from Darwinism, and approaches to that which has been called mediate creation, or creation under natural law.

With respect to the origin of man himself, which is no doubt the most important point, these difficulties are enormous. Man can be traced only a little way back in geological history, not further than the Pleistocene period, and the earliest men are still men in all essential points, and separated from other animals, recent and fossil, by a gap as wide as that which exists now. Further, if from the Pleistocene to the modern period man has continued essentially the same, this, on the principle of gradual development, would remove his first appearance not only far beyond the existence of any remains of man or his works, but beyond the time when any animals nearly approaching to him are known to have existed. This is independent altogether of the further difficulties which attend the spontaneous origin of the mental and moral nature of the human species. It would seem, then, that man must have been introduced, not by a process of gradual development, but in some abrupt and sudden way. Even Wallace, who has all along adhered to the doctrine of natural selection in its integrity, while he agrees with Darwin that man must be a descendant of apes as to his bodily frame,† maintains that his higher mental and moral faculties must have had another origin.

These considerations have led many of the more logical and thoughtful of the followers of Darwin to the position of supposing not a gradual, but an intermittent and sudden development, and this, in the main, in the earliest periods of the history of living beings. In a very able essay by Dr. Alpheus Hyatt, in the *Proceedings* of the Boston Society of Natural History, this view is very fully stated in its application to animals. On the one hand, Hyatt holds that the biological facts and the geological evidence as it has been stated by Marcou, Le Conte, Barrande, Davidson, and by the writer,‡ precludes the idea of slow and uniform change proceeding throughout geological time, and he holds justly that the idea of what he calls "a concentrated and accelerated process of evolution," in early geological times, brings

* Clelland, *Journal of Anatomy and Physiology.*
† *Darwinism*, p. 461.
‡ *Modern Ideas of Evolution* (6th ed. London, 1891).

the doctrine of development nearer to the position of those great naturalists like Cuvier, Louis Agassiz, and Gegenbauer, who have denied any genetic connection between the leading animal types. He quotes Cope and Packard in support of his view on this point. Cope has, in a series of brilliant essays,* endeavored to illustrate what he terms "causes of the origin of the fittest." Of this kind are growth-force modified by retardation or acceleration of development produced by unfavorable or favoring conditions, the effects of use and disuse on modifying structures, the law of correlation of parts and the effects of animal intelligence. All of these causes are ignored by the genuine Darwinian. Nevertheless they exist in nature, though rather as causes of mere adaptive variation than of specific difference.

Another modification of orthodox Darwinism is that of Romanes, who may almost be regarded as Darwin's most prominent successor. He has introduced the idea of physiological selection—that is, of the occurrence accidentally or from unknown causes of reproductive changes which render certain individuals of a species infertile with others. The effect of this would be an isolation amounting to the erection of two forms not reproductive with each other; or, in other words, of two species not gradually differentiated, but distinct from the first. This is really an inversion of Darwin's theory, in which the initial stage of Romanes is necessarily the culmination of the development. It differs also essentially in eliminating the idea of use and adaptation to change implied in the theory of natural selection.

Romanes even goes so far as to stigmatize the adherence to natural selection pure and simple as "Wallaceism," in contradistinction to Darwinism, while he admits that Wallace has a good right to adhere to this view, as having in some sense antedated Darwin in asserting the dominant influence of natural selection. It is fair to say, with regard to Romanes, that while advocating the importance of physiological selection, he claims that Darwin admitted, or would have admitted, this factor, since he believed that in the absence of infertility to prevent intercrossing, natural selection would fail to produce new species. It is worthy of remark here that both Romanes and Wallace seem to be aware that this admission might be fatal to the doctrine of natural selection, unless they can show some other cause capable of producing infertility.

In the meantime, Weismann in Germany has, in the name of what has been called pure Darwinism, introduced into the discussion facts and considerations as destructive to the usual doctrine as Puritanism would be to High Churchism. He contends that all evidence is against the perpetuation by heredity of characters acquired by the individual. Only characters born with him can be perpetuated. For example, a man born with six fingers on his hand may have six-fingered children, but a man who acquires in his lifetime manual dexterity, or who loses a finger by accident, will not transmit either peculiarity. Weismann has undoubtedly made out a strong case in favor of this contention, which would at once overthrow the Lamarckian theory of evolution, and would remove one of the subsidiary props of Darwinism, throwing it back entirely on the natural selection of fortuitous congenital variations. Purified in this way, and reduced to chance variation, perpetuated by accidental action of favoring circumstances, Darwinism would, according to some of its adherents, evaporate without leaving any residuum. Nor has it escaped notice that the theory of Weismann implies profound and far-reaching considerations respecting the independence of the germinal matter of animals of individual peculiarities, and its constancy to the ideal plan of the species, which would help to account for the wonderful permanence of types in geological time, while it would oppose change, except when this arises from causes directly affecting the reproductive function.

Another important point involved in Weismann's results is the probability that, while asexual reproduction, as, for instance, that of budding, tends to perpetuate individual peculiarities, whether of advance or retrogression, ordinary reproduction tends to eliminate all variations, whether produced by habit and use or by obscure causes affecting the individual in its lifetime. Thus there is a strong barrier set up, especially in the higher organisms, against either degradation or elevation. Advantage has been taken of this by some speculators to suggest that new species may have originated by parthenogenesis, that is to say, by what theologians would call miraculous conception, and this idea has by some of them been connected even with the nativity of our Lord on the earth. But such speculations are very far removed from even the borders of science.

A curious point, little thought of by most evolutionists, but deserving consideration here, is that to which Herbert Spencer has given the name "direct equilibration," or the balance of parts and forces within the organism itself. The body of an animal, for example, is a very complex machine, and if its parts have been put together by chance, and are drifting onward on the path of evolution, there must necessarily be a continual struggle going on between the different organs and functions of the body, each tending to swallow up the other, and each struggling for its own existence. This resolution of the body of any animal into a house divided against itself, is at first sight so revolting to common sense, and so hideous to right feeling, that few like to contemplate it; but it has been brought into prominence by Roux and other recent writers, especially in Germany, and it is no doubt a necessary outcome of the evolutionary idea. For why should not the struggle of species against species extend to the individuals and the parts of the individual? On this view, the mechanism of an animal ceases even to be a machine, and becomes a mere mass of conflicting parts thrown together at random, and depending for its continued existence on a chance balance of external forces. Fortunately, geological history completely negatives this idea, by showing the extreme permanence of many forms of life which have continued to propagate themselves through almost immeasurable ages and great changes of environment, without material variation, and the apparent fixity of these in their final forms.

Viewed rightly, the direct equilibration of the parts of animals and plants is so perfect and so stable, and such great evils arise from the slightest disturbance of it by the selective agency of man, that it becomes one of the strongest arguments against the production of new species by variation. This has been well shown by T. Warren O'Neill,* who adduces a great number of facts, detailed by Darwin himself, to show that when the stability of an organism is artificially altered by man in his attempt to establish new breeds, infertility and death of these varieties or breeds results; and if this happens under the fortuitous selection supposed to occur in nature, any considerable variation would result either in speedy return to the original type or in speedy extinction. In other words, so beautifully balanced is the organism that an excess or deficiency in any of its parts, when artificially or accidentally introduced, soon proves fatal to its existence as a species; so that, unless nature is a vastly more skillful breeder and fancier than man, the production of new species by natural selection is an impossibility.

Two remarkable books by two of the ablest exponents of the Darwinian theory of evolution have appeared, which may be taken as specimens of the evolutionary method, and may be commended to those who desire to know this theory as defended and extended by its friends.† One of these works is by Alfred Wallace, who may be truly said to have anticipated Darwin in the theory of natural selection—the other by Dr. Romanes, Darwin's successor. Both claim to be orthodox Darwinians, though each accuses the other of some heresy. Wallace's book may, however, be accepted as the best English exposition of Darwinism in general, that of Romanes as the ablest attempt to explain on this theory the evolution of the higher faculties of man. Neither professes to explain the origin of life, but both profess, life and species of animals being given, to explain their development as high as man himself, though they differ materially as to this highest stage of evolution, and also as to the omnipotence of natural selection. The judicious reader will, however, observe that both take for granted what should be proved; in other words, reason constantly in a narrow circle, and constantly use such formulæ as "we may well suppose" instead of argument.

Take as a specimen from Wallace the history of evolution of the water-ouzel or dipper. It may serve as an example of the questions which are raised by the Darwinian evolution, and which, if they have no other advantage, tend to promote the minute observation of nature, of which Wallace's book shows many interesting examples. It serves, at the same time, to illustrate that peculiar style of reasoning in a circle which is characteristic of this school of thought. This special illustration from Wallace has been chosen be-

* *Origin of the Fittest*, in *American Naturalist*.

* *Refutation of Darwin* (Philadelphia, 1880).

† *Darwinism*, by Wallace; *Mental Evolution in Man*, by Romanes.

cause it is one in which the idea of adaptation to fill a vacant space—an idea as much Lamarckian as Darwinian—is introduced.

"An excellent example of how a limited group of species has been able to maintain itself by adaptation to one of these 'vacant places' in nature is afforded by the curious little birds called dippers or water-ouzels, forming the genus *Cinclus* of the family *Cinclidæ* of naturalists. These birds are something like small thrushes, with very short wings and tail and very dense plumage. They frequent, exclusively, mountain-torrents in the northern hemisphere, and obtain their food entirely in the water, consisting, as it does, of water-beetles, caddis-worms, and other insect larvæ, as well as numerous small fresh-water shells. These birds, although not far removed in structure from thrushes and wrens, have the extraordinary power of flying under water; for such, according to the best observers, is their process of diving in search of their prey, their dense and somewhat fibrous plumage retaining so much air that the water is prevented from touching their bodies, or even from wetting their feathers to any great extent. Their powerful feet and long curved claws enable them to hold on to stones at the bottom, and thus retain their position while picking up insects, shells, etc. As they frequent chiefly the most rapid and boisterous torrents, among rocks, waterfalls, and huge bowlders, the water is never frozen over, and they are thus able to live during the severest winters. Only a very few species of dipper are known, all those of the Old World being so closely allied to our British bird that some ornithologists consider them to be merely local races of one species; while in North America and the Northern Andes there are two other species.

"Here, then, we have a bird, which, in its whole structure, shows a close affinity to the smaller typical perching birds, but which has departed from all its allies in its habits and mode of life, and has secured for itself a place in nature where it has few competitors and few enemies. We may well suppose that, at some remote period, a bird which was perhaps the common and more generalized ancestor of most of our thrushes, warblers, wrens, etc., had spread widely over the great northern continent, and had given rise to numerous varieties adapted to special conditions of life. Among these some took to feeding on the borders of clear streams, picking out such larvæ and mollusks as they could reach in shallow water. When food became scarce they would attempt to pick them out of deeper and deeper water, and while doing this in cold weather many would become frozen and starved. But any which possessed denser and more heavy plumage than usual, which was able to keep out the water, would survive; and thus a race would be formed which would depend more and more on this kind of food. Then, following up the frozen streams into the mountains, they would be able to live there during winter; and as such places afforded them much protection from enemies and ample shelter for their nests and young, further adaptations would occur, till the wonderful power of diving and flying under water was acquired by a true land bird."*

Here it will be seen that a bird, distinctly marked off by important structures and habits from others, is supposed to have originated from a different species at some remote period, by efforts to obtain food in what, to it, must have been an unnatural way; and the sole proof of this is the expression, "we may well suppose." Why may one not as well suppose that all the perching birds were at first like water-ouzels, which would accord with the early appearance of aquatic birds, and that they gained their diverse forms by availing themselves of the better circumstances and more varied food to be found in the woods and fields, so that the water-ouzel may be a survival of a primitive type? Neither theory can be proved, and the one is as likely as the other, perhaps the latter, of the two, the more likely, and neither actually explains anything. It is to be observed, also, as already hinted, that the kind of evolution in this, as in some other cases supposed by Wallace, is rather Lamarckian than Darwinian.

It is interesting to note that, though wedded to that strange mode of reasoning of which the extract above given furnishes an example, Wallace frankly and fully admits three of the great breaks in the continuity of evolution. First, he admits that the introduction of life at first can not be accounted for, because no way is known in which mere chemical combination can produce living protoplasm. Here, he says, "we have indications of a new power at work which we may call Vitality." Secondly, he sees no cause in the continuous evolution for the introduction of animal sensation and consciousness. No attempt at explanation by any modification of protoplasm can here "afford any mental satisfaction, or help us in any way to a solution of the mystery." He sees a similar break of continuity in the introduction of the higher faculties of man. "These faculties could not have been developed by means of the same laws which have determined the progressive development of the organic world in general and also of man's physical organism." These he refers to an unseen universe—to a world of spirit to which the world of matter is altogether subordinate. If one refers these three great steps to a spiritual Creator, and eliminates on the other side, the known development of varietal forms, the field for the Darwinian evolution becomes greatly narrowed.

Romanes, the author of the other work, will listen to no such compromises; but, on the other hand, is willing to admit a union of the Darwinian and Lamarckian doctrines, besides sexual selection and other factors, which are admitted also by Spencer. His latest work is devoted to the bridging over the third of the gaps above mentioned, as in a previous work he had dealt with the second. He does not affirm that he has fully succeeded, but that, by considering the case of savages and of prehistoric man, we "are brought far on the way toward bridging the psychological distance which separates the gorilla from the gentleman." It is one thing, however, to be on the way to a chasm, and another to be assured that there is a good bridge over it. If one succeeds in crossing with him from instinct to animal intelligence, from this to rational thought, from this to ethical judgments and to the belief in God and immortality, and along with all this to speech, there is the following reward in regard to one step of the progress: "I believe that this most interesting creature (speechless man) lived for an inconceivably long time before his faculty of articulate sign-making had developed sufficiently far to begin to starve out the more primitive and more natural systems; and I believe that even after this starving-out process did begin, another inconceivable lapse of time must have been required to have eventually transformed *Homo alalus* into *Homo sapiens*." A process which thus requires two eternities in which to pass through two of its stages may well stagger the credulity of ordinary specimens of *Homo sapiens*, and may surely be dismissed as itself "inconceivable."

While however, the conclusions of Romanes are thus somewhat unsatisfactory, his book contains much that is valuable, more especially with reference to the perfectly legitimate questions relating to the development of civilization, and of new ideas and inventions in human history. Man is not confined, like the lower animals, within the range of unvarying instinct. He is gifted with inventive and progressive powers, and in the study of the progress of these there is scope for much psychological inquiry and discussion, though it is evident that human progress is not of the nature of a slow and gradual evolution, but rather by sudden leaps under the influence of superior genius and mental power, and it is all within the specific limits of man, and in no respect tends to the production of a new species.

The modern hypotheses of evolution present themselves to the Christian under two aspects—the theistic and the atheistic or agnostic, for the two last are practically the same. The theistic evolutionist holds that God creates, but that created things may have powers of spontaneous evolution, under laws whereby they may pass into new and higher forms. The atheist and the agnostic eliminate the idea of a Creator, and reduce everything to the action of atoms and forces supposed to be practically and inherently omnipotent. They thus make of these atoms and forces a supreme God, attributing to them the same powers assigned by the theist to the Creator. It is obvious, however, that many adherents of evolution have no clear perception of the distinction between these phases, or find it convenient to overlook its existence, since they often hover in thought between the one and the other, or occupy one or the other position indifferently, as the exigencies of debate may require.

It is also to be observed that either of these phases of evolution may admit of modifications. One of the most important of these arises from the distinction between the idea of slow and uniform development maintained by Darwin and others, and that of sudden or intermittent evolution advocated by such evolutionists as Mivart and Le Conte.

* *Darwinism*, pp. 116, 117.

Viewing the matter in this light, it is evident that neither the theological idea of creation nor the evolutionist notion, in either of its phases, can have any close dependence on biological and geological science, which studies the nature and succession of organic forms without ascertaining their origin; either hypothesis may, however, appeal to scientific facts as more or less according with the consequences which might be expected to follow from the origins supposed. It is further evident that, should evolutionists be driven by natural facts to admit the sudden apparition of organic forms rather than their gradual development, there may be no apparent difference, as to matter of fact, between such sudden apparition and creation, so that science may become absolutely silent on the question.

Palæontology has indeed tended to bring the matter into this position, as Barrande and others have well shown. The writer has elsewhere adduced the advent of the Cambrian trilobites, of the Silurian cephalopods, of the Devonian fishes, of the Carboniferous batrachians, land snails and myriapods, of the marsupial mammals of the Mesozoic and the placental mammals of the Eocene, and of the Palæozoic and modern floras, as illustrations of the sudden swarming in of forms of life over the world, in a manner indicating flows and ebbs of the creative action, inconsistent with Darwinian uniformity, and perhaps unfavorable to any form of evolution ordinarily held.*

This neutral attitude of science has been strongly insisted on by Dr. Wigand † in his elaborate work *Darwinismus*, in which he holds that this doctrine does not represent a definite and consistent scientific effort and result, but merely an "indefinite and confused movement of the mind of the age," and that science may ultimately prove its most dangerous foe. In like manner the veteran German physiologist Virchow, in an able address before the Assembly of German Naturalists at Munich,‡ taking the spontaneous generation of organisms and the descent of man from apelike ancestors as test questions, argues in the most conclusive manner that neither can be held as a result of scientific investigation, but that both must be regarded as problems as yet unsolved.

But in the face of such opinions as these, one is struck with the fact that eminent men of science in England and America assert that science demands belief in the theory of evolution, and this in its atheistic as well as its theistic phase. When, however, reasons are asked for this demand, those who make it are themselves obliged to admit the absence of a scientific basis for the doctrine. For example, reference may be made to the able and elaborate address delivered before the American Association by its president, Prof. Marsh. He says: "I need offer no argument for evolution, since to doubt evolution is to doubt science, and science is only another name for truth." In the sequel of the address he limits himself to the evolution of the vertebrate animals, admitting that he knows nothing of the absolute origin of the first of them, and basing his conclusions mainly on the succession, in distant times, and often in distant places, of forms allied to each other, and advancing in the scale of complexity. Such succession obviously falls far short of scientific proof of evolution; and other than this no evidence is offered for the strong assertion above quoted. In the conclusion of the address he asserts that life may be a form of some other force, presumably physical force: but admits in the same breath that we are ignorant of its origin; and finally he makes an appeal, not to facts, but to faith: "Possibly the great mystery of life may thus be solved; but whether it be or not, a true faith in science knows no limit to its search for truth."

Another eminent apostle of evolution, Prof. Tyndall, asserts, in a public address, that "it is now very generally admitted that the man of to-day is the child and product of incalculable antecedent time. His physical and intellectual textures have been woven for him through phases of history and forms of existence which lead the mind back to an abysmal past." But, however generally this may be "admitted," it is nevertheless true that the oldest known men are as truly human in their structures as those now living, and that no link between them and lower animals is known. In a previous address he had gone further back still, and affirmed that in material atoms reside the "promise and potency of life"; yet in his capacity of physicist he has by rigid experiments in his laboratory done as much as any man living to convince us that science knows no possibility of producing the phenomena of life from dead matter.

The man who in a popular address or in a text-book introduces the "descent of species" as a proved result of science, to be used in framing classifications and in constructing theories, is leaving the firm ground of nature and taking up a position which exposes him to the suspicion of being a dupe or a charlatan.* He is uttering counterfeits of nature's currency. It should not be left to theologians to expose him, for it is as much the interest of the honest worker in science to do this as it is that of the banker or merchant to expose the impostor who has forged another's signature. In the true interests of science one is called on to follow the weighty advice of Virchow: "Whoever speaks or writes for the public ought, in my opinion, doubly to examine just now how much of that which he says is objective truth. He ought to try as much as possible to have all inductive extensions which he makes, all conclusions arrived at by the laws of analogy, however probable they may seem, printed in small type under the general text, and to put into the latter only that which is objective truth." To practice such teaching may require much self-denial, akin to that which the preacher must exercise who makes up his mind to forego his own thoughts, and, like Paul, to know nothing among men but God's truth in its simplicity. The mischief which may be done to science by an opposite course is precisely similar to that which is done to religion by sensational preaching founded on distortions of scriptural truth, or on fragments of texts taken out of their connection and used as mottoes for streams of imaginative declamation.

To render such evils impossible, there must be a more general and truthful teaching of science. It is a great mistake here to suppose that a little knowledge is dangerous; every grain of pure truth is precious, and will bear precious fruit. The danger lies in misusing the little knowledge for purposes which it can not serve; and this is most likely to take place when facts are not known at all, or imperfectly comprehended, or so taught as to cause a part of the truth to be taken for the whole. Let the structures of animals and plants in some of their more prominent forms be well known, along with their history in geological time, and the attempt to explain their origin by any crude and simple hypotheses like those now current will become unreal as a dream.

It may be useful in conclusion to say a few words on the application of the doctrine of evolution to other lines of investigation than that of organic development. Here it is scarcely necessary to remark that when one speaks of the evolution of the physical universe from disseminated atoms, of chemical elements from one original substance, of continents and mountain-chains in geological time, or, on the other hand, of the arts and languages and history of men, new and diverse fields are entered, in which the developments which may occur are altogether different in their nature and dependent on different causes; in which consequently the term evolution must in each case have a distinct and peculiar meaning, unless indeed the reader is prepared to use it to designate any mode of doing anything, in which case it loses all distinctive significance.

In the case of the physical universe one must assume space and time, matter and energy, with all their laws and potencies, and has then before him the question of the possible interactions of these in time, their possible determination in a given direction, with or without a planning creative mind, and in the things developed one has to deal with the inorganic and the dead, altogether destitute of the plastic and progressive vital energies of the organic world. Evolution in this sense is merely the movement of a machine, the original construction of which no theory of evolution can *per se* explain. When, on the other hand, the evolution of human history or human art is discussed, an entirely different plane is reached. Here a planning intelligent mind deals with external objects and molds them to its will. Here also the new factor of genius appears as a sudden inspiration from time to time, giving at once a great

* In England, Davidson, Jeffreys, Williamson, Carruthers, and other eminent naturalists have strongly insisted on the tendency of palæontological facts to prove permanence of type and intermittent introduction of new forms, as distinguished from descent with gradual modification.

† Dr. Albert Wigand, *Darwinismus* (1875–77).

‡ On the *Liberty of Science* (1877).

* Huxley, in the preface to the *Manual of the Anatomy of the Invertebrated Animals* (1878), has taken this ground. He says: "I have abstained from discussing questions of ætiology, not because I underestimate their importance, or am insensible to the interest of the great problem of evolution, but because, in my mind, the growing tendency to mix up ætiological speculations with morphological generalizations will, if unchecked, throw biology into confusion."

and rapid impulse. All history shows that in this way, and by great bounds, advance has been secured, and not by any slow and gradual process of mere struggle and survival. Here also the subject becomes infinitely complicated with the varieties of human taste, feeling, and reason, and with the infinite interaction of interests and opportunities.

The vague and indefinite application of the term evolution to all these modes of development and to their innumerable and complicated causes and determinations has perhaps more than anything else tended to disgust men of common sense with this protean and intangible philosophy, and to divorce it more and more from the alliance of rigid science. On the other hand, its vague and shadowy character, and the pretension to explain all things by one dominant idea have great charms for the unwary and enthusiastic crowd, and it gives a cheap and easy way of appearing learned and philosophical, which has a peculiar attraction for an age characterized by a superficial and confused expansion of thought and discussion, and by an intense craving for the exciting and sensational. These elements of the thought of the age must for some time longer give currency to the abundant coinage of a mint which so easily converts the base metal of speculation into the semblance of scientific conclusions. J. WILLIAM DAWSON.

Evolutions, Military: the movements by which troops change the order, position, and direction of their primary formation. All such movements as marching, countermarching, changing front, forming line, facing, wheeling, defiling, deploying, etc., come under the general head of evolutions. All evolutions are performed according to a regulated system, which differs in its details in the armies of different nations.

Ev′ora (anc. *Ebora* and *Liberalitas Juliæ*): town of Portugal; capital of the province of Alemtejo; pleasantly situated about 73 miles by rail E. by S. from Lisbon (see map of Spain, ref. 17–B). It has two ruined forts, a large Gothic cathedral founded in 1186, several convents, a library, manufactures of cotton, cloth, and hats, and a trade in wine. It has been an archbishop's see since 1541. Ebora was taken by Sertorius about 80 B. C. Here are Roman antiquities which are more interesting than any others in Portugal. Among them are an aqueduct said to have been built by Sertorious; a temple of Diana with beautiful Corinthian columns; and a brick tower adorned with columns of the Ionic order. Pop. about 14,000.

Évremond, *āv′r′mōṅ′*, CHARLES DE SAINT-DÉNIS: seigneur de Saint-Évremond; a French courtier and *littérateur*; b. near Coutances, in Normandy, Apr. 1, 1613. He was witty and accomplished, a perfect specimen of an Epicurean of that time, squandering his life in the pursuit of frivolous pleasures, and ready to give it up at any moment for the sake of a bon-mot. He entered the army about 1629, and became a friend of Turenne and the Prince of Condé. Having given offense to Louis XIV. by his raillery and sarcastic wit, he took refuge in England in 1662. He gained the favor of Charles II., who granted him a pension of £300, and he never returned to France. He wrote dramas, essays, and letters, of which his *Comédie des Académistes pour la Réformation de la Langue François* is an exceedingly witty, elegant, and entertaining production. His *Sir Politics*, which he wrote in company with Buckingham, is very weak. D. Sept. 20, 1703.

Évreux, *ā′vrö′* (anc. *Mediolanum*, afterward *Eburovices*): city of France; capital of the department of Eure; pleasantly situated on the Iton; about 67 miles by rail W. N. W. of Paris, with which it is connected by railway (see map of France, ref. 3–E). It is a bishop's see, and has a fine old cathedral, an episcopal palace, a theater, a clock-tower built in 1417, and a botanic garden. Here are manufactures of cotton and woolen fabrics, leather, etc. Évreux has sustained numerous sieges. It was taken and pillaged by Rollo the Norman in 892 A. D., and was burned by Henry I. of England in 1119. Pop. (1896) 17,766.

Ewald, *ā vaalt*, GEORG HEINRICH AUGUST, von: Orientalist and biblical critic; b. at Göttingen, Germany, Nov. 16, 1803. He became Professor of Philosophy in the University of Göttingen in 1831, and Professor of Oriental Languages in 1835. In 1837 he was removed on account of his liberal political opinions, he and five other professors, among whom were Gervinus and Grimm, solemnly protesting against the abolition of the free constitution which the Hanoverian king had felt himself compelled to give during the revolutionary commotions in 1830. He went to Tübingen as professor in 1838 (first in the philosophical and then in the theological faculty), but became involved in conflicts with Catholics, Pietists, and Hegelians (F. C. Baur and the Tübingen school), and could not be contented in his new home. He was reinstated in his chair at Göttingen in 1848, and was elected a member of the North German Parliament in 1869, where he was a bitter opponent of Prussia. In 1874 he was found guilty of a libel on Prince Bismarck, and was sentenced to three weeks' imprisonment. His critical judgment was not equal to his learning, and his character was marred by excessive arrogance; but his influence on his generation was enormous. He wrote grammars of Hebrew and Arabic, numerous commentaries on the Old and New Testaments, a history of Israel, a work on biblical theology, and numerous articles touching almost every point of Semitic learning in his *Year-books of Biblical Science* (1849–65). D. in Göttingen, May 4, 1875.

Revised by C. H. TOY.

Ewald, *ā′vaald*, HERMAN FREDERIK: Danish novelist; b. in Copenhagen, Dec. 13, 1821. After writing several stories of modern life, he turned his attention to the historical romance, with which he has been very successful. Of his books may be mentioned *Valdemar Krones Ungdomshistorie* (The Story of Valdemar Krone's Youth, his first publication, 1860); *Familien Nordby* (The Nordby Family, 1862); *Johannes Falk* (1865); *Svenskerne paa Kronborg* (The Swedes at Kronborg, 1867); *Agathe* (1873); *Knud Gyldenstjerne* (1875); *Niels Brahe* (1877); *Anna Hardenberg* (1880); *Dronningens Jomfruer* (The Queen's Maidens, 1885); and *Griffenfeld* (1888). G. L. KITTREDGE.

Ewald, JOHANNES: Danish poet; b. in Copenhagen, Nov. 18, 1743. He gave early evidence of that fickleness and weakness of will that caused most of his subsequent misfortunes, running away to join the Prussian army in 1759, and then almost immediately deserting to the Austrians. After some six months' soldiering he returned home and studied theology. His literary activity, which continued till his death, began in 1765 with an unsuccessful didactic poem. Four years later his drama *Adam og Eva* (Adam and Eve) was published and gained him immediate recognition. He was at this time dominated by Klopstock and his school. In 1770 appeared his prose tragedy *Rolf Krage*, which is chiefly of interest as indicating the direction in which the Romantic school of the next century was to turn for material. It exhibits him as still under the influence of Klopstock. *Balder's Død* (The Death of Balder), a tragedy in iambic pentameters, marks a distinct advance in independence of his models and in poetic power. Its influence on OEHLENSCHLÄGER (*q. v.*) makes its appearance in 1773 an important date in Danish literature. Between *Rolf Krage* and *Balder's Død* Ewald had written various lyrics and occasional poems; an essay, *Om Pebersvende* (On Bachelors), remarkable for its humor and elegance; and three comedies in the manner of Holberg: *De brutale Klappare* (The Brutal Clappers), *Pebersvendene* (The Bachelors), and *Harlequin Patriot*. He spent 1773–77 in the country in poverty and ill-health, induced in part by his drinking habits. From this time dates one of his most admired poems, *Rungsteds Lyksaligheder* (The Blessings of Rungsted). In 1777 he returned to Copenhagen, where he lived in improved circumstances till his death, Mar. 17, 1781. In Copenhagen he became the idol of the literary society known as the "Danish Club," which upheld German models in opposition to Wessel's "Norwegian Club," which looked to France for instruction. He had, however, freed himself from Klopstockism. His best work, the comedy of *The Fishers* (*Fiskerne*), was written in 1778. All Ewald's writings possess an historical interest, but it is as a lyric poet that he is chiefly remembered. In this department of poetry he ranks among the greatest names of modern Scandinavian literature. His two best songs, *Kong Kristian stod ved høien Mast* (King Christian stood by the High Mast) and *Liden Gunvor* (Little Gunvor), which occur in *The Fishers*, are among the most popular of Danish lyrics. A careful edition of Ewald's works (*Johannes Ewald's Samlede Skrifter*, 8 vols.) by F. L. Liebenberg appeared 1850–55. See also A. D. Jørgensen, *Johannes Ewald* (1888).

G. L. KITTREDGE.

Ewell, *yu′el*, BENJAMIN STODDERT, LL. D.: soldier and educator; son of Dr. Thomas Ewell and Elizabeth Stoddert; b. in the District of Columbia, June 10, 1810; graduated at West Point, 1832; served while lieutenant Fourth Artillery as assistant professor at the U. S. Military Academy 1832–36; resigned, 1836; civil engineer 1836–39; Professor of Mathematics and Natural Philosophy at Hampden-Sydney College 1839–46; Professor of Mathematics and Military Science at Washington College 1846–48; acting president and Professor of Mathematics, College of William and Mary, 1848–49; Professor of Mathematics and Natural Science 1849–61; president 1854–88. He served in the Confederate army in command of the Thirty-second Regiment Virginia Volunteers 1861–62, and as adjutant-general, with the rank of colonel, to Gen. Joseph E. Johnston, while commanding the departments of Tennessee and Mississippi 1862–64. In 1874 he received the degree of LL. D. from Hobart College, N. Y. D. in James City, Va., June 19, 1894.

Ewell, Richard Stoddert: son of Dr. Thomas Ewell and Elizabeth Stoddert; b. in the District of Columbia, Feb. 8, 1817; graduated at West Point in 1840; served with distinction on the frontier and in the Mexican war as lieutenant and captain in the First Regiment of Dragoons 1840–61; resigned and served with the Confederates as lieutenant-colonel, colonel, brigadier-general, major-general, and lieutenant-general 1861–65, participating in the battles of first and second Manassas, in the latter of which he lost a leg, Front Royal, Cross Keys, Port Republic, and Cedar Mountain; assigned, on the death of Jackson, to the command of his, the Second, corps of Lee's army, which he led at the capture of Winchester, at Gettysburg, Wilderness, and Spottsylvania Court-house; relieved from duty in the field because of physical inability, and ordered to take charge of the department of Richmond; captured, on Lee's retreat, at Sailor's Creek; moved after the war to Tennessee. D. in Springfield, Tenn., Jan. 25, 1872.

Ewer, yu'er, Ferdinand Cartwright: clergyman; b. at Nantucket, Mass., May 22, 1826; graduated at Harvard, 1848; was ordained a minister in San Francisco, 1858; came to New York in 1860; became assistant minister of St. Ann's; in 1862 rector of Christ Church; but developing ritualistic tendencies he resigned, and his friends formed for him the new Church of St. Ignatius, 1871, in the same city, and he was its rector till his death. He made a great stir by his *Sermons on the Failure of Protestantism* (New York, 1869). Died while on a visit to Montreal, Oct. 10, 1883.

Ewing, yu'ing, Finis: one of the fathers of the Cumberland Presbyterian Church; b. in Bedford co., Va., June 10, 1773, of Scotch-Irish stock; is said to have studied for a time in college. He removed to a place near Nashville, Tenn., and in 1823 married a daughter of Gen. William Davidson; joined a Presbyterian church, and soon after removed to Kentucky. Awakened in 1800 to a new religious life, he was licensed to preach, and in 1803 was ordained by the Cumberland presbytery. His ordination not being recognized by the Kentucky synod, the presbytery being dissolved, and the action of the synod being sustained by the General Assembly, he with two others in 1810 formed the germ of the new Cumberland Presbyterian Church. In 1820 he removed to Missouri. D. July 4, 1841.

Ewing, James Alfred, B. Sc., F. R. S.: Professor of Engineering and writer on electro-technics, especially in the domain of magnetism; b. in Dundee, Scotland, Mar. 27, 1855; educated at the High School of Dundee and at Edinburgh University, where he graduated in science; was assistant to Sir William Thomson in telegraph engineering, then Professor of Engineering at the University of Tokio 1878–83. Since 1883 he has been Professor of Engineering in University College, Dundee. Professor Ewing is the author of an important work, *Magnetic Induction in Iron and other Metals* (1892); also of many important papers on electricity and magnetism, and upon the measurement of earthquake motion, a subject to which he gave much attention while in Japan.

Ewing, Gen. Thomas: See the Appendix.

Ewing, Thomas, LL. D.: statesman; b. near West Liberty, Ohio co., Va., Dec. 28, 1789. In 1792 he removed with his parents to Ohio. In his youth he prepared himself for college by night study, while employed in the Kanawha salt-works. In 1815 he graduated at Ohio University at Athens, receiving the first degree of A. B. ever conferred in that State. He was called to the bar in 1816; U. S. Senator from Ohio 1831–37 and 1850–51: U. S. Secretary of the Treasury (1841) under Harrison, and Secretary of the Interior under Taylor (1849). He was the father of Gen. Thomas Ewing (b. Aug. 7, 1829; d. Jan. 21, 1896), and father-in-law of Gen. W. T. Sherman. D. at Lancaster, O., Oct. 26, 1871.

Exactions [from Lat. *exac'tio*, act of driving out, forcing out, a forced contribution; deriv. of *exi'gere*, exact; *ex*, out + *a'gere*, drive]: a legal term of ecclesiastical jurisprudence, used in the Middle Ages to denote such duties or contributions, demanded by the clergy of their parishioners, as were extraordinary, either because they were new and against custom or because their amount was unduly increased. They were illicit, and it was found necessary repeatedly to denounce their unlawfulness. The power of the clergy over their parishioners, or of the bishops over the subordinate clergy, was so great that it was easy for them to make the most outrageous exactions. In 589 the third Council of Toledo forbade the bishops "exactiones diocesi vel damna infligare," and the meaning of this is more exactly defined by Leo IV., who in 853 forbade the bishops to exact from the clergy and ecclesiastical institutions of their dioceses "dationes ultra statuta patrum aut super appositæ in angariis." Yet, in 1179, Alexander III. found it necessary to repeat: "Prohibemus ne ab abbatibus, vel episcopis, aliisve prælatis novi census imponantur ecclesiis, nec veteres augeantur, nec partum redituum suis usibus appropriare præsumant."

Example-books: same as Exempla-books (*q. v.*).

Exarch [from Gr. ἔξαρχος, leader, chief]: in ancient Greece, the person who conducted the dramatic chorus during the performance, as distinguished from the coryphæus and the choregos, of whom the former was the teacher of the chorus, generally the author of the play, while the latter was simply some rich citizen who supplied the costs of the outfit of the chorus. Later on the title was used in the Eastern Church to denote the highest ecclesiastical dignity, and was bestowed on the bishops of Alexandria, Antioch, Ephesus, Cæsarea, and Constantinople, but was soon exchanged in most places for that of patriarch, though it never was wholly abolished. At present it denotes a chancellor or deputy under the patriarch in the Russian Greek Church. He travels as a delegate from the patriarch through the diocese, investigating the discipline of the monasteries and the observance of the canons, and forming a kind of court of appeals in all ecclesiastical cases arising between the clergy and the people.

As a civil officer, an exarch was a viceroy intrusted with the administration of one or more provinces. The title was given especially to the prefects who from the middle of the sixth century until the middle of the eighth governed that part of Italy which was subject to the Byzantine empire. The line began with Narses, an officer of Justinian, who reconquered Italy from the Ostrogoths. They held their court at Ravenna, combining civil, military, and often ecclesiastical authority. They appointed dukes as vice-governors for several parts of Italy, and these often made themselves independent. The exarchate was finally destroyed by the Lombards in 752; three years later Pepin of France conquered Ravenna and ceded it to the pope. The title of exarch for high civil and military officers was employed in Western Europe until the twelfth century.

Excam'bion [a doublet of *exchange*, *excambium* being the Med. Lat. form of Ital. *scambio*, subst. of *scambiare* < Lat. *ex* + *cambia're*]: in the law of Scotland, an exchange of lands, or the contract by which one piece of land is exchanged for another. The term is chiefly used in laws and treatises relating to the rights of heirs possessing lands under deeds of entail. They are empowered to exchange, or excamb, certain portions of them (not amounting in value to more than one-fourth in value of the entailed estates) for other lands contiguous to, or convenient to be held with, the entailed lands. Revised by F. Sturges Allen.

Ex cath'edra [Lat., from out the chair; Lat. *cathedra* = Gr. καθέδρα, seat]: a phrase originally applied to decisions given by popes or prelates in a solemn judicial manner. Hence it is applied to every decision pronounced by any one in the exercise of his proper authority, as a judge on the bench, etc.

Excellency [from Lat. *excellentia*, superiority, deriv. of *excel'lere*, be eminent]: a title of honor given to ambassadors, governors of British colonies, and the Governor of Massachusetts. The President of the U. S. and the governors of many of the States have the same title by courtesy. In former times it was applied only to sovereign princes.

Excelmans, ek'sel'maañ', or **Exelmans**, Remi Joseph Isidore, Baron: a French marshal; b. at Bar-le-Duc, Nov. 13, 1775. He entered the army in 1791, and became aide-de-camp to Murat in 1801. He served with distinction at Austerlitz (1805), and gained the rank of general of brigade for his conduct at Eylau (1807). In the Russian campaign (1812) he commanded a division and gave proof of much skill. He directed a corps at the battle of Waterloo (1815), after which he passed four years in exile. He was restored to his title as a peer in 1831, and became a marshal of France in 1851. D. July 10, 1852.

Excelsior Springs: city; Clay co., Mo. (for location of county, see map of Missouri, ref. 3–D); on the Ch., Mil. and St. P. Railway; 30 miles N. E. of Kansas City. It is situated in an agricultural region, and is a summer resort. Pop. (1890) 2,034; (1900) 1,881.

Exchange [with restoration of Lat. prefix *ex-*, from O. Fr. *eschange* (> Mod. Fr. *échange*): Ital. *scambio* < deriv. of Lat. *ex*, out + *cambia're*, change]: (1) a place of meeting (also called a *bourse*) of traders in any given line of business, as stock exchange, produce exchange, etc.; (2) commercial paper and the transactions to which it gives rise. Bills of exchange as a method of commercial settlement are probably of nearly coincident date with the origin of commerce. De Paw says that bills of exchange were used at Athens, and were known among the Arabs. The Abbé Raynal says they were known in the East Indies when the Portuguese first arrived there. Macpherson says there is no express mention of them in any known record until the beginning of the thirteenth century, when the pope, in the plenitude of his power as sovereign of the world, offered the kingdom of Sicily and Apulia to King Henry III. on the condition that he would drive Manfred out of it. Henry accepted it for his second son, and authorized the pope to carry on the war against Manfred at the expense of England; whereupon the pope took up large sums from the Italian merchants, who were compensated by drawing bills on the English prelates and sending agents to collect them. Owing to the balance of trade or debt between any two places, either domestic or foreign, there may be a difference of value between a given quantity of gold or silver in such places respectively. This difference is called the exchange, and it is generally expressed by a percentage on the bill that is bought for remittance. The exchange is said to be at *par* when there is no such difference, or "when a given quantity of gold in one country is convertible at the market-price into such an amount of the currency of that country as will purchase a bill of exchange on the other country for such an amount of the currency of that other country as will there be convertible at the market-price into an equal quantity of gold of the same fineness." Exchange is said to be in favor of a country when a given quantity of gold purchased in it is convertible into such an amount of the currency of another country as will there be convertible into a *greater* quantity of gold of the same fineness; and it is said to be adverse, or against a country, when the proceeds of a bill of exchange will yield in the country to which it is transmitted a *smaller* quantity of gold of the same fineness. The effective limitation, therefore, to the price of a bill of exchange designed for transmission to another country is the cost of sending gold. The exchange will ordinarily rise to the height of the cost of transmitting gold, which is made up of freight, insurance, interest, and brokerage; but if there is little gold in a country, and if the sources of supply are uncertain, it may greatly exceed that cost, especially if the balance of foreign debt be adverse. The principal circumstance which determines the cost of gold in a country is the state of its foreign account. If its exports are continuously less than its imports, it must transmit gold or silver to pay the difference.

Payments of money to be transmitted from the U. S. to France or Germany are usually made with bills of exchange drawn payable in the standard money of those countries. Remittances of money payable in other foreign countries are commonly made in bills of exchange drawn on London, the chief monetary center of the world.

The act of Congress of Mar. 3, 1873, provided that the values of the standard coins of the various nations should be estimated annually by the director of the mint, and be proclaimed on the first day of January by the Secretary of the Treasury. (See Coinage.) It also provided that in all payments by or to the treasury, whether made in the U. S. or in other countries, where it becomes necessary to compute the value of the sovereign or pound sterling, it shall be deemed equal to \$4.8665; the same rate to be used in appraising merchandise imported, when the value is by invoice in sovereigns or pounds sterling. It also provided that this rate should be used in the construction of contracts payable in sovereigns or pounds sterling; that this valuation should be the par of exchange between Great Britain and the U. S.; and that all contracts made after the first day of Jan., 1874, based on an assumed par or exchange with Great Britain of 54*d.* to the dollar, or \$4.44$\frac{4}{9}$ to the sovereign or pound sterling, should be null and void.

Soon after the passage of the act the Secretary of the Treasury issued a circular, from which it appears that by a usage dating back to an early period in colonial history the dollar had been rated as equivalent to 54*d.* sterling; the pound therefore at \$4.44$\frac{4}{9}$, or £9 = \$40. The dollar, which was the original subject of comparison, was the old Spanish silver dollar, or piece of eight reals, and the computation at the time was approximately true, as compared with the British silver money. In all transactions of exchange involving the dollar and British money the par was therefore assumed at 54*d.* to the dollar, any difference from this par being represented by premium or discount.

The true par value of the pound sterling is \$4.8665, and the fictitious par, at the assumed rate of 54*d.* to the dollar, is \$4.4444. Formerly dealers selling exchange charged a nominal premium of 9$\frac{1}{2}$ per cent. on the fictitious par of \$4.444. In appearance, exchange was heavily against the U. S., when, in truth, there was neither premium nor discount, as 9$\frac{1}{2}$ per cent. on \$4.4444 gives exactly \$4.8665. Thus, through a pure fiction, retained by usage only, and not by any law, exchange with Great Britain appeared permanently *against* the U. S., whose bonds were quoted at a fixed discount of nearly 8$\frac{2}{3}$ per cent. below their real value. The remedy for such anomalies lay in the abandonment of the false par or valuation of the moneys of the U. S. in British money, and it was to this object that the law referred to was directed. In quoting exchange on foreign countries it had never been the practice, except in dealings with Great Britain, to assume a par upon which a percentage was rated. The universal rule, except in this case, was to quote the money of the U. S. against the money of other countries. Thus on France and the franc countries, exchange was quoted in francs and centimes to the dollar; on Prussia, cents to the thaler; on Frankfort, cents to the florin; and so on. In reforming practice with Great Britain the same method was adopted, and exchange on London is now quoted as so many dollars and cents to the pound sterling. Revised by A. T. Hadley.

Exchange, Bill of: See Bill of Exchange and Exchange.

Exchequer [with false use of Lat. prefix *ex-* from M. Eng. *escheker* < O. F. *escheker*, checker-board, the checkered table on which accounts were computed, a court of revenue; a deriv. of O. Fr. *eschecs*: Ital. *scacchi*, chess (Eng. *chess* from O. Fr. *eschès*, another form of same), ultim. from Pers. *shāh*, king]: a former superior British court of record, more fully designated as the *Court of Exchequer*. See Exchequer, Court of.

Exchequer Bills: negotiable interest-bearing bills issued at the Exchequer, under the authority of acts of Parliament, as security for money advanced to the Government. The receipts of the British treasury from the ordinary sources of taxation amounted in 1891–92 to £75,604,119. The mode of collecting and disbursing sums of money so large as this may greatly enhance or diminish the burden of the taxpayers, and in a corresponding degree affect the interests of the receivers. The withdrawal of any considerable portion of the revenue from the pockets of the people and placing it in the treasury as a hoard in waiting to meet the liabilities of expenditure would very seriously affect the movements of business. The policy of the exchequer-bill system very happily obviates such disturbance of the money movement of the kingdom. The investments in these bills are almost entirely drawn from the inactive capital of business people. For such service the exchequer-bills are admirably adapted. They vary but a trifle, and when they can be had are always in demand; they never enter into the currency circulation, and rarely appear in the reports of the British money market. They are issued in denominations of £100, £200, £500, and £1,000 bills, and have ten half-yearly coupons attached stating that the bearer is entitled to the interest on the sum named, but not stating the amount of the interest, as that is fixed from year to year and can never exceed 5½ per cent. per annum. It is now usually about 2¼ per cent. At the end of each twelve months the holders may claim payment of the principal sum named on the face of the bill, but at no other time. They are used as reserves of the English banks and bankers, and may be tendered during the last six months of every year in payment of customs, excise, and other duties payable to the Government. They were first brought into use by Chancellor Montague, Earl of Halifax, at the time of the great financial difficulties attendant upon the recoinage and the over-issue of the Bank of England to the Government in the earliest years of its existence. From that time on, through two centuries, they have been so useful as to have become a prominent feature of the British fiscal system. Their normal function is to anticipate the income of those taxes which are payable only at such periods as are too distant from each other to meet the daily drafts upon the treasury. The taxes of this class amount to about the half of the annual revenue of the kingdom, and in that proportion require an artificial adjustment as to the times of answering to their current disbursement. The bills are usually made redeemable about the time the incoming taxes shall reach the treasury. One of their excellent adaptations to service is in the circumstance that they furnish the funds to the common currency by the price at which they are sold to capitalists in advance of the equivalent demand made upon the taxpayers, providing the Government, at a small rate of expense, with the avails of the internal taxes, and at the same time providing beforehand the currency for payment without affecting the general volume in the service of the business community. The U. S. has never had anything corresponding to the British exchequer-bills policy. Revised by A. T. HADLEY.

Exchequer Chamber, Court of: in England, originally a court of all the judges of the three superior courts of common law, assembled for the decision of matters of law. By 1 Will. IV., c. 70, this court was constituted the proper tribunal for the trial of writs of error from the three superior courts of common law. The judges of two of these courts always formed the court of appeal, which reviewed the decisions of the third. Error lay from this court to the House of Lords. It is now abolished and its jurisdiction in appeals is transferred to the court of appeal under the Judicature Acts. See COURTS. Revised by F. STURGES ALLEN.

Exchequer, Chancellor of the: the title of the highest finance minister of the British Government. This office is from its nature necessarily intrusted to a Commoner. When the Prime Minister is a member of the House of Commons, he sometimes holds the office of Chancellor of the Exchequer. See CHANCELLOR.

Exchequer, Court of: in England, one of the three superior courts of common law which were abolished by the Judicature Acts, this court being constituted the exchequer division of the high court of justice. It was originally established for the recovery of the king's debts and ordinary revenues of the crown. The judges of this court consisted originally of the Lord Treasurer, the Chancellor of the Exchequer, and three puisne judges, which last were called barons of the exchequer. In its later shape it became, in fact, a combination of eight distinct ancient courts. It acquired concurrent jurisdiction with the other two superior courts in all personal actions by the fiction of the plaintiff being a debtor to the king—a fiction which was abolished by 2 Will. IV., c. 39. It had exclusive jurisdiction in cases in which the royal revenue was concerned, and also had an equitable jurisdiction, which was abolished by 5 Vict., c. 5, and transferred to the court of chancery. The court at the time of its abolition consisted of six judges—viz., the chief baron and five barons of exchequer. Error lay from this court to the COURT OF EXCHEQUER CHAMBER (*q. v.*); see also COURTS.

Ireland had a court of exchequer, consisting of a lord chief baron, three barons, and a master, with the necessary clerks and other inferior officers, but it was abolished as such by the Supreme Court of Judicature Act (Ireland), 1877, being constituted the exchequer division of the high court of justice in Ireland. Scotland had, until the year 1856, an exchequer court which decided questions relating to revenues and customs, and to honors, estates, forfeitures, and penalties arising to the crown. Its authority and jurisdiction was transferred to the court of session, which was declared to be the court of exchequer in Scotland. One of the lords ordinary appointed by the crown acts as a lord ordinary in exchequer cases. Revised by F. STURGES ALLEN.

Exchequer Tallies [*tally* is connected with Fr. *tailler*, to cut]: tallies of wood by means of which, up to the year 1783, the English exchequer checked its accounts. The checking was done as follows: Seasoned wands of hazel, ash, or willow were inscribed on one side with the sum for which the tally was an acknowledgment, and on the other with the Roman characters indicative of the same sum, with the date and payer's name. Notches of varied appearance stood for various amounts. The deputy chancellor then split the stick with knife and mallet in such a way that each check was divided; and when the payer presented his tally for payment, it was first matched with its corresponding tally in the exchequer office. This ancient and clumsy device was nevertheless an almost perfect protection against forged applications for money. The old tallies were stored in the Parliament House, and in 1834 Parliament ordered them to be burned. The flues became superheated in consequence, and the building itself was destroyed.

Excipient, or **Vehicle** [*excipient* is from Lat. *exci'pere*, take up, undertake; *ex*, out + *ca'pere*, take]: in pharmacy, an inert substance used to give form and consistence to solid preparations, such as pills and *dragées*, or to give palatability and the necessary qualities for administration to any medicine. The various conserves, also honey, treacle, simple sirups, glycerin, white of egg, and mucilage of acacia, are among the most useful excipients.

Excise, ek-sīz' [by folk-etym. corruption (as if meaning a cutting out) from M. Eng. *assise* < O. Fr. *asise*, *assise*, deriv. of *asseoir* < Lat. *asside're*, sit down to; *assize* is the continuance of the correct form]: a tax on goods of home production, as distinct from customs or duties on imports. The term excise is chiefly used in Great Britain, the corresponding term in the U. S. being internal revenue. The British excise system as a system dates from the Long Parliament in 1643, duties being levied to support the army against Charles I. It was continued after the Restoration, and further extended in 1733. At the beginning of the nineteenth century taxes of this kind were widespread and oppressive. Under the leadership of Sir Robert Peel, beginning about 1844, there was a gradual abolition of the excise duty upon many articles, with the most useful results to trade. In 1849 the boards of excise, stamps, and taxes were united as commissioners of inland revenue. The present revenue of the United Kingdom from taxes of this kind is upward of £25,-000,000. The chief duties of the sort in France are those upon spirits, wine and beer, on tobacco and snuff, and on gold and silver plate, while with them may be included legacy and succession duties and stamp taxes on various commercial transactions. For similar taxes in the U. S., see INTERNAL REVENUE and FINANCE. A. T. HADLEY.

Excito-motor Action: in physiology, that variety of reflex action which, arising from impressions made at the periphery (internal or external), is first transmitted by afferent nerve-filaments to a nerve center, and thence reflected without volition along motor (deferent) nerve-filaments to a muscle, which is thereby aroused to action. For example, a sudden impression of light causes the pupil of the eye to contract; the presence of a particle of food in the glottis causes intense involuntary coughing. (See REFLEX ACTION.) Excito-motor action is peculiarly active in very young children and in many of the lower animals. In some diseases (tetanus, hydrophobia, strychnia poisoning) it is immensely increased. Chloral, belladonna, curari poison, and especially the alkaloid curaria—all appear powerfully to reduce action of this kind.

Exclusion Bill: in English history, a bill which was designed to exclude the Duke of York (King James II.) from the throne, because he was a Roman Catholic. It was adopted by the House of Commons in 1679, but was rejected by the House of Lords. See CHARLES II. and JAMES II.

Excommunication [from deriv. of Eccles. Lat. *excommunica're*, put under ban; *ex*, out of + *communica're*, communicate; *commu'nis*, common, shared]: the formal expulsion of a person from privileges religious or social, inflicted by church authority upon persons accused of misconduct or heresy. The ancient Israelites excommunicated offenders by exclusion from the camp, by "cutting off from the people," and in later times by "putting out of the synagogue." This punishment, in extreme cases at least, was a social interdict of the severest kind. Excommunication in the Christian Church was established by Christ's teachings, and by the precept and example of the apostles, and was necessary both for the self-preservation of the Church and for the spiritual and moral good of the offender. In early times—as also in the Roman Catholic and in several of the Reformed Churches at present—there was a lesser and a greater excommunication; the former a virtual suspension from Church privileges, the latter a formal expulsion. The greater excommunication in the Latin Church is less severe than the anathema. Excommunication was not unfrequently employed by the popes in former times as a punishment for refractory monarchs, and even for whole nations, but in later times it has not been so employed, the so-called excommunication of Victor Emmanuel in 1860 being merely a statement of the ecclesiastical penalties which the pope might inflict upon the invaders of the pontifical domains. In Prussia and Switzerland the excommunication of the Old Catholic priests by the Catholic bishops in 1871–73 brought on severe conflicts between the state and the Church. Excommunication is rarely resorted to in modern days in any other than the Roman Communion.

Exe, eks (anc. *Isaca*): a river of England; rises in Exmoor, in Somersetshire, flows generally southward through Devonshire, and after a course of 54 miles enters the English Channel at Exmouth. The chief towns on its banks are Tiverton and Exeter.

Execution: in civil law, the formality of signing, sealing, and delivering a deed, or of signing and publishing a will; in civil actions, the carrying out the final judgment of the court, or, more strictly, the writ directing the sheriff, coroner, or marshal to carry such judgment into effect.

Under the law of England, there were three writs in constant use to enforce a judgment for the payment of money: 1, a writ of *fieri facias*, commonly called a *fi. fa.*, directing the officer to cause to be made the amount of the judgment out of the goods and chattels of the debtor; 2, a writ of *elegit*, given by statute of 13 Edw. II., directing the officer to deliver the goods and chattels of the debtor to the creditor at an appraised value, in satisfaction of the judgment, and, if these are insufficient, to put him in possession of one-half the debtor's land till the rents and profits satisfy the judgment; 3, a writ of *capias ad satisfaciendum*, commonly called a *ca. sa.*, directing the officer to arrest the debtor and keep him in confinement till he satisfies the judgment.

The English practice has been somewhat changed in the State of New York. There are two writs of execution—one against the property, and one against the person, of the debtor. The former, which resembles the *fi. fa.*, directs the sheriff to satisfy the judgment out of the personal property of the debtor within the county, and, if sufficient can not be found, then out of his real property, and to return the writ within sixty days. The latter, like the *ca. sa.*, directs the officer to arrest the debtor and keep him in jail till he pays the judgment or is discharged according to law. Since the act of 1831 abolishing imprisonment for debt this writ is allowed in comparatively few cases, as when the debt was contracted in fraud, or the debtor has attempted to remove his property, or has violated his duty in some trust relation. Under the execution against the property the sheriff sells at public auction the real and personal property of the debtor, though a variety of articles necessary for the prosecution of a business and support of a family are exempted, as also a homestead to the value of one thousand dollars, subject to certain conditions. If the judgment is for the recovery of specific real or personal property, the execution directs the sheriff to deliver such property to the plaintiff. Many other States of the Union have closely followed the New York practice.

Although these proceedings are instituted by the party in whose favor the judgment is rendered, they are considered as the acts of the law, and the officer intrusted with their performance is responsible to the party aggrieved for any misconduct or neglect of duty.

Executive Department, The: in the U. S. Government, the branch of the public service which attends to the execution of the laws of the General Government. This department is under the direct control of the President, who is the principal executive officer. The duties of the Executive Department are the most extensive of all. It makes all civil, naval, and military appointments, and manages the army and navy, collects customs and internal revenue, sells public lands, and pays all appropriations authorized by Congress. The Secretary of State, of the Treasury, of the Interior, of War, of the Navy, the Postmaster-General, the Attorney-General, and the Secretary of Agriculture take rank next the President as officers of the Executive Department; they together constitute the cabinet, which, by usage, has become a consulting or advisory council to the President. See UNITED STATES.

Executor [Lat. *exsecu'tor*, one who carries into effect, deriv. of *ex'sequi, exsecu'tum*; *ex*, out + *se'qui*, follow]: one to whom a testator commits the execution of his last will. The will is the source of the executor's title, and the probate (or proof) of the will is merely evidence of it. As a general rule, any one capable of making a contract can be an executor. In England, an infant may be appointed executor, but can not act as such during minority. In many of the U. S. it is provided by statute that no person under twenty-one is competent to act as executor. The chief duties of an executor are to bury the deceased in a manner suitable to the estate which he leaves, to prove the will, make an inventory of his goods, collect the assets, and pay the debts and legacies. An executor has general control over the personal estate, and possesses the same property in it as the testator had when living, and the same remedies to recover it. He has no power over the real estate, unless it is given to him by the will, or unless the local law gives it to him when the personal property is insufficient to pay the debts. When he has authority given to him in a will to control the real estate, he is not deemed to act as an executor, but either as a trustee or the grantee of a power, according to the nature of the authority conferred upon him.

An executor *de son tort* is one who interferes with the goods of a deceased person without lawful authority. He has the trouble of an executor without the advantages. He may be sued as executor if any assets have come into his hands, but can not bring an action as executor.

In some States, executors are required to give bonds for the faithful discharge of their duties, and in others the probate court has a right to require them to furnish security if there is any doubt of their solvency.

Exege'sis, or **Exeget'ical Theology** [*exegesis* is Gr. ἐξήγησις, interpretation, deriv. of ἐξηγεῖσθαι, lead the way, prescribe, tell at length, explain; ἐξ, out + ἡγεῖσθαι, lead]: the first and most important part of theological science, covering the whole field of biblical literature, or all that pertains to the learned explanation of the Old and New Testaments. It originated among the Jewish rabbis, but was afterward far more extensively cultivated among the Christian Fathers, the Reformers, and the divines of all ages, and is now engaging more attention than ever before. It has received much impulse from Oriental discoveries (in Egypt, Palestine, Babylon, and Assyria) and from the advances in the knowledge of the classical and Semitic languages. It is taught as a science and practiced as an art in all theological institutions, and its results are applied from every pulpit throughout the Christian world.

I. *Kinds of Exegesis.*—(1) *Philological* or grammatico-historical exegesis is the basis on which all other interpretation and application must rest. It aims simply at the meaning of the writer according to the recognized laws of language and the *usus loquendi* at the time of composition, and according to the historical situation of the writer, irrespective of any doctrinal or sectarian bias. It implies a thorough knowledge of Greek and Hebrew, and familiarity with contemporary literature. (2) *Theological* exegesis develops the doctrinal and ethical ideas of the writer in organic connection with the whole teaching of the Scriptures and according to the analogy of faith. (3) *Practical* or *Homiletical* exegesis is the application of the well-ascertained results of grammatical and theological interpretation to the wants of the Christian congregation, and belongs properly to the pulpit, the Bible class, and the Sunday-school.

II. *Auxiliary and Supplementary Branches.*—(1) *Sacred Philology*, the science of the languages in which the Bible was originally written—viz., the Hebrew in the Old Testament (with a few sections in the cognate Semitic dialect called Chaldee or biblical Aramaic), and the Greek in the New Testament. The latter is not the classical Greek, but the Macedonian or Alexandrian dialect, with a strong Hebrew coloring (hence called the Hellenistic, because spoken by the Hellenists, i. e. the Greek Jews) and the infusion of the spirit of Christianity, which created new words or inspired a deeper meaning into old words. The New Testament Greek requires, therefore, a particular study, special grammars (i. e. Winer, Buttmann, Jr.), and special dictionaries (Wahl, Bretschneider, Wilke, Grimm, Cremer, Robinson, Thayer).

(2) *Biblical Archæology* or *Antiquities*—i. e. a systematic description of the external and internal condition of the nations among which, and the countries in which, the Bible was composed. This includes, again, the geography and natural history of Palestine and adjacent countries, the topography of Jerusalem, an account of the domestic habits, social institutions, agriculture, arts and science, religious rites, and ceremonies of the Hebrews. The material of Jewish antiquities is derived mostly from the Bible itself, but also from Philo and Josephus, the Talmud, the monumental remains from Egypt, Assyria, Babylon, and the accounts of modern explorers down to the labors of the Palestine Exploration Societies of England, Germany, and the U. S.

(3) *Biblical Criticism* is twofold—textual (also called lower) and literary (also called higher). *Textual* criticism deals with the form or letter of the Bible, and aims at the approximate restoration of the original text as it came from the hands of the authors. The autographs being lost, recourse must be had to the oldest uncial manuscripts, which date from the fourth and fifth centuries. Besides, we have partial and secondary sources of the Greek text in the very numerous Scripture quotations of the Christian Fathers (Origen, Irenæus, Eusebius, Chrysostom, Ambrose, Jerome, etc.), and the old translations (especially the Syriac Peshitta, the Latin Itala, and the improved Vulgate of Jerome). Textual criticism includes a discussion of the merits of the received text (*textus receptus*, derived from Erasmus, Stephens, Beza, and Elzevir), the principles for ascertaining the oldest and purest text, the classification of manuscripts and different readings, and a history of the printed text from Erasmus and the Complutensian Polyglot down to Lachmann, Tischendorf, Tregelles, Westcott and Hort. There is a gradual approach to an agreement among the best critics, and the conviction of the essential integrity of the primitive text has been greatly strengthened by the latest discoveries (e. g. the *Codex Sinaiticus*), the full publication of the *Codex Sinaiticus* (St. Petersburg, 1863), and the *Codex Vaticanus* (in fac-simile, 1889), and the investigations of the leading critical editors. *Literary* or historical criticism deals with the contents of the Bible and investigates the questions of authorship, and all the historical surroundings of the several books as also their collection into a collective body or canon.

(4) *Historico-critical Introduction to the Books of the Old and New Testaments* is a literary history of the Bible, and includes all the introductory information necessary for the proper understanding of its contents, as the question of the genuineness and integrity of the book, the persons addressed, the place and time of composition, the object and aim of the writer. It gives also a history of the canon or collection of the several books of the Bible into one authoritative code, distinct from all other books, and recognized as a rule (**κανών**) of faith and morals by those who receive them. The principal works on introduction are by De Wette, Hug, Bleek, Reuss, Weiss, Holtzmann, Godet, Horne, Davidson, Haverniek, Keil, Ewald, Wellhausen, Driver, Cornill. Compare also the *Bible Dictionaries* of Kitto (3d ed. by William L. Alexander, 3 vols.), William Smith (ed. with improvements by Hackett and Abbot, in 4 vols.; revised English ed., 1893, *sqq.*), Fairbairn, Winer, Schenkel, Riehm, Schaff.

(5) *Biblical Hermeneutics*—i. e. the science of the principles of interpretation, and the necessary qualifications for an expounder of the Scriptures. These qualifications are partly intellectual (familiarity with the general laws of thought and speech, knowledge of the particular languages of the Bible, sound judgment) and partly moral (freedom from prejudice, readiness to do justice to the author, sympathy with his spirit and ideas). Works by Fairbairn, Immer, Terry, Diestel, Farrar.

(6) *Biblical Theology of the Old and New Testaments* is a summing up of the results of exegesis in systematic order, and presents a full view of the teaching of the Scriptures, irrespective of the subsequent systems of denominational dogmatics and ethics derived from them. This branch of exegetical theology is of recent growth, and has thus far been mostly cultivated by continental scholars. There are also special treatises on the theology of Christ, the theology of Paul, John, and Peter. Each of the apostles, as he has his own peculiar style, represents also a special aspect of the Christian system; yet all harmonize and exhibit together the fullness of the Gospel. Compare the works of Schmid, Baur, Weiss, and Van Oosterzee on New Testament Theology; Ewald, Schultz, and Oehler on Old Testament Theology; and Wendt on the teaching of Jesus (1892).

III. *History of Exegesis and Principal Commentaries.*—(1) *Jewish* exegesis, confined to the Old Testament. It began soon after the close of the canon. It was especially devoted to the Law (the Thorah), i. e. the Pentateuch, and derived from it minute rules for the individual, social, and ecclesiastical relations. The body of these interpretations is called *Midrash*. The prevailing method of exegesis was the rabbinical or literal; it excluded all foreign ideas, and was subservient to the strict legalism of the Pharisees. But among the Hellenist (Greek-speaking) Jews, especially in Alexandria, the allegorizing method obtained favor, especially through Philo (d. about 40 A. D.), who endeavored to combine the Mosaic religion with Platonic philosophy, and prepared the way for the allegorizing exegesis of Clement and Origen of Alexandria. The Jewish rabbins of the Middle Ages cultivated grammatical exegesis at a time when the knowledge of Hebrew had died out in the Christian Church. The most distinguished among them are Ibn Ezra (d. 1167), R. Sal. Isaak or Raschi (d. 1105), David Kimchi (d. 1190), Moses Maimonides (d. 1204). Their commentaries are printed separately, and also in the so-called Rabbinical Bibles e. g. of Buxtorf (3 vols., Basel, 1618).

(2) *Patristic Exegesis.*—The first use made of the Bible in the Church was practical and homiletical. It was to the early Christians what it still is to the great mass of believers, and will be to the end of time—a book of life, of spiritual instruction and edification, of hope and comfort. Scientific or learned exegesis began when the Bible was perverted by heretics and made to serve all sorts of errors. The Greek Church took the lead. Origen (180–254), the greatest scholar of his age, a man of genius and iron industry, is the father of critical exegesis. He is full of suggestive ideas, but far from being sound. His theory of hermeneutics is untenable, and opens the way for the most fanciful and arbitrary expositions or impositions. He distinguishes three senses in the Bible, corresponding to the three parts of man: (*a*) a literal or bodily sense; (*b*) a moral or psychic sense; (*c*) an allegorical or mystic, spiritual sense. Where the literal sense is offensive, he escaped the difficulty by adopting a purely spiritual sense. The greatest commentators of the Greek Church are Chrysostom (d. 407), who in his *Homilies* explained the principal books of the Old and New Testaments, Theodore of Mopsuestia (d. 429), Theodoret of Cyros (d. 457). Among the Latin Fathers, Augustine (d. 430) is the profoundest and most spiritual, Jerome (d. 419) the most learned and critical, expounder. The latter achieved the highest merit by his improved Latin version of the Bible (the Vulgate), which remains to this day the standard version of the Roman Church. The Council of Trent forbade the interpretation of Scriptures except according to "the unanimous consent of the Fathers." But this rule, strictly carried out, would prevent all progress in theology; and besides, such a "unanimous consent" does not exist except in the most fundamental doctrines.

(3) *Mediæval exegesis* was purely traditional, and consisted of brief glosses (*glossaria*) or of extracts from the Fathers (called *catenæ Patrum*). The original languages of the Bible were almost unknown in the West, and even the first among the scholastics depended upon Jerome's version for their knowledge of God's word. The prevailing method distinguished four senses of the Scriptures: (*a*) the literal or historical; (*b*) the spiritual or mystic, corresponding to faith, teaching what to believe (*credenda*); (*c*) the moral or tropological, which corresponds to love or charity, and teaches what to do (*agenda*); (*d*) the anagogical, which refers to hope (*speranda*). The principal patristic compilations are (*a*) in the Greek Church, those of Œcumenius (d. 990), Theophylactus (d. 1007), Euthymius Zigabenus (d. 1118), and Nicephorus (fourteenth century); (*b*) in the Latin Church, Wallafried Strabo (d. 849), Thomas Aquinas (d. 1274). The *Catena aurea in Evangelia* of Thomas Aquinas has been reproduced in a scholarly English translation by Pusey, Keble, and Newman. Among the more independent biblical scholars of the Middle Ages who prepared the way for the Reformation must be mentioned Nicolaus à Lyra (d. 1340: "*Si Lyra non lyrasset, Lutherus non saltasset*"), and Laurentius Valla (d. 1465), the pioneer of biblical and historical criticism.

(4) The exegesis of the *Protestant Reformers* of the sixteenth century marks a new epoch. It is full of enthusiasm for the word of God in the Bible as the only rule of Christian faith and practice, and free from the slavery of ecclesiastical tradition. It went directly to the original Greek and Hebrew Scriptures, and furnished the best translations

for the benefit of the people, while Romanism regards the Bible as a book for the priesthood, and discourages or prohibits efforts for its general circulation without note or comments. All the Reformers wrote commentaries more or less extensive on various books of the Bible—Luther (d. 1546), Melanchthon (d. 1560), Zwingli (d. 1531), Œcolampadius (d. 1531)—but the ablest of them are Calvin (d. 1564), and his pupil Beza (d. 1605). Calvin combines all the qualifications of an expounder in rare harmony, and his commentaries on Genesis, the Psalms, the Prophets, and all the books of the New Testament (except Revelation) are valuable to this day.

(5) Protestant commentaries of the seventeenth and eighteenth centuries by Hugo Grotius (d. 1645, Arminian), Vitringa (d. 1722, Dutch Calvinist), Hammond (d. 1660, Church of England), Mathew Poole (Presbyterian, d. 1679, *Annotations upon the Whole Bible*, an English synopsis from his Latin synopsis). Matthew Henry (Presbyterian, d. 1714, the best homiletical commentator of England), John Gill (Baptist, d. 1771), Philip Doddridge (Independent, d. 1751, author of *Family Expositor*), Calovius (Lutheran, d. 1686, *Biblia Illustrata*, versus Grotius), J. A. Bengel (Lutheran, d. 1752, author of the *Gnomon of the New Testament*, in Latin, twice translated into English, an admirable specimen of *multum in parvo*). Collective works: *Critici Sacri* (London, 1660, 9 tom.; Amsterdam, 1698–1732, in 13 vols. compiled from the principal commentators as an appendix to Walton's *Polyglot*, under the direction of Bishop Pearson and others); Poole's *Synopsis Criticorum aliorumque S. Scripturæ interpretum* (London, 1669–76, 4 vols. in 5 fol., a very useful abridgment from the *Critici Sacri* and other commentators).

(6) Modern commentaries, chiefly German, English, and American: (*a*) On the whole Bible: Lange's *Bibelwerk* (Bielefeld and Leipzig, 1857, *sqq.*), a threefold commentary, critical, doctrinal, and homiletical, prepared by a number of continental, mostly German, divines, for the use of ministers and students; the same in English, with large improvements and additions by more than forty Americans scholars of all denominations, under the editorial care of Philip Schaff (25 vols., New York and Edinburgh, 1864–80; new ed. 1884, *sqq.*); *The Speaker's Commentary*, suggested by the Speaker of the House of Commons, ed. by Canon F. C. Cook, aided by a number of bishops and presbyters of the Church of England (10 vols., London and New York, 1871–82); Strack and Zöckler, *Kurzgefasster Commentar zum A. und N. Test.* (including the Apocrypha, Nördlingen, 1886, *sqq.*); other commentaries on the whole Bible by Reuss; Bishop Chr. Wordsworth; Jameson, Fausset, and Brown; Ellicott; the *Expositor's Bible*; the *Pulpit Commentary*; Butler's *Bible Work*; *The Cambridge Bible for Schools*; and Methodist and Baptist Commentaries (popular). (*b*) On the Old Testament: Keil and Delitzsch (orthodox); the *Exeget. Handbuch zum A. T.*, by Dillmann and others (critical), several editions. (*c*) On the New Testament: Olshausen, De Wette, and especially Meyer (the first philological commentator; d. 1874; continued by Weiss and others), Holtzmann, Lipsius, and others, among the Germans; Alford among the English—all for critical students. Of popular commentaries of the New Testament, Barnes has had by far the widest circulation in America and England, but is now replaced by others edited by Bishop Ellicott, Dr. Schaff (*International Commentary on the N. T.*, illustrated, New York, 4 vols.), etc. The nineteenth century has also produced a large number of exegetical works of the first order on separate books of the Bible, which it would be impossible here to enumerate. Among recent commentators on one or more books of the Old Testament, Gesenius, Ewald, Hupfeld, Hitzig, Hengstenberg, Delitzsch, Dillmann, Schlottmann, Moses Stuart, Joseph A. Alexander, Perowne, occupy the first rank. Of New Testament commentators must be mentioned Winer, Fritzsche, Tholuck, Lücke, Bleek, Harless, Heinrici, Godet, Stuart, Hodge, Stanley, Jowett, Ellicott, Westcott, Milligan, Brown, Beet, Edwards, Lightfoot, and M. R. Vincent. Among these, again, Tholuck on Romans and the Sermon on the Mount, Lücke on the Writings of St. John, Harless on Ephesians, Hodge on Romans, Ellicott on Galatians, Ephesians, Thessalonians, and Pastoral Epistles (republished in Andover), Lightfoot on Galatians, Philippians, and Colossians, Westcott on the Gospel and Epistles of John and on Hebrews, Godet on Luke, John, Romans, and Corinthians, are most useful for the critical study of the Greek Testament.

PHILIP SCHAFF.

Exempla-books [from Lat. *exem'plum*, orig., that which is taken out as a sample; from *exi'mere*, to take out, *ex-*, out + *emere*, buy, take]: collections made in mediæval times of stories introduced into sermons (usually at the close) to illustrate some precept or to arouse the attention of the congregation. The technical word employed in mediæval literature to denote a story used for such a purpose was *exemplum*. Gregory the Great used legends in this way in his homilies (before 604), but the practice did not become common until the end of the twelfth or the beginning of the thirteenth century, when the foundation of the Franciscan and Dominican orders gave a great impulse to preaching, and entirely changed its character. It became necessary to interest and amuse the common people who had gradually become accustomed to an entertaining literature more and more secular in its nature, and who possessed, moreover, an innate love for tales. St. Dominic himself, we are told, abounded in stories, and almost all who played an important part in the use of *exempta*, either by employing them in their sermons or by collecting them for other preachers, were Dominicans. The most notable exception to this rule was the eminent prelate Jacques de Vitry, Bishop of Acre, later cardinal and historian of the crusades, the date of whose death is uncertain (about 1240). He was the author of several collections of sermons (only the *Sermones in Epistolas et Evangelia Dominicatia totius anni* have been printed, Antwerp, 1575) in one of which, the *Sermones vulgares* (written probably late in life), he employed *exempla* to such an extent that henceforth their use in sermons addressed to the people became customary.

The fame of Jacques de Vitry as a preacher, and the attractive character of his illustrative stories, early led to a demand for some convenient edition of the *exempta* alone. Probably the first form was a collection of *exempta* accompanying the sermons (such an edition of the fourteenth century is in the National Library at Paris), and then of the *exempla* alone (there are a number of such independent collections as early as the thirteenth century). Subsequent preachers employed *exempla* more or less frequently, and the practice naturally led to abuses which are mentioned by Dante (*Paradise*, xxix. 103–120), and against which various councils of the Church directed edicts.

The demand for *exempta* soon led to the preparation of collections varying in size and contents. The chief sources of these collections were the *Vitæ Patrum*, the *Diatogues* of Gregory, the *Diatogus Miracutorum* of Cæsar of Heisterbach, the legends of the Church, Valerius Maximus, and the *exempta* already used by Jacques de Vitry and others. The form of these collections is usually alphabetical, and they are all anonymous. One of the most interesting is the *Alphabetum narrationum* (the anthor of this happens to be known: he was Étienne de Besançon, general of the Dominican order, d. 1294), which was never printed, although a Catalan translation of the fifteenth century was published at Barcelona in 1881, under the title *Recull de eximptis e miracles, gestes e faules e altres ligendes ordenades, per A. B. C.* With the invention of printing the numerous older manuscript collections were replaced by a few printed ones, which enjoyed enormous popularity. These were fresh compilations and not reprints of the earlier manuscript ones. Their sources were the same, and they may be divided into two classes: those containing *exempla* pure and simple, and those containing *exempla* with an application or moral appended (moralized natural history, etc.). The best of this class is the *Speculum Exemptorum*, an anonymous work first printed at Deventer in 1481, and revised in 1603 by Johannes Major, a Jesuit of Douay, who added 160 *exempta* to the 1,215 of the original work, and arranged the whole in alphabetical order, placing at the end of each *exemptum* the source from which it was taken. Besides such independent collections, several preachers took the trouble to append to their collected sermons a *promptuarium* or repository of *exempla*, the object of which was partly to enable the user of the sermons to vary the stories contained in them, and partly to afford preachers in general a magazine of illustrations. The most famous *Promptuarium* is that of John Herolt, a Dominican monk of Basel, who flourished during the first half of the fifteenth century. The arrangement is the usual alphabetical one by topics, and the work contains 114 chapters, under 20 letters, embracing 917 *exempla*, of which 283 are found in the sermons and only referred to in the *Promptuarium*.

These collections were soon imitated, and vast compilations of historical and local anecdotes arose, the most important of which are the *Promptuarium Exemplorum* of Andreas Hondorff (d. 1572), and the *Fleurs des Exemples ou Catéchisme historical* of Antoine d'Averoult, a Jesuit who died in 1614. It is interesting to note that the use of stories in sermons is still frequent enough to call for modern collections, and that a number of such, one bearing the time-honored name of *Promptuary*, have been published.

The second class of exempla-books mentioned above contains stories to which have been appended a moral conclusion or an explanation of the hidden or allegorical meaning of the story. For this class fables and parables were extensively used, as well as the symbolical interpretation of natural history. To this class belong such works as the fables of Odo of Cheriton, the *Moralizationes* of Robert Holkot, an English Dominican, the *Gesta Romanorum*, and the *Scala Celi* of Johannes Junior (his surname was Gobii, and he was from Alais, in the south of France). Of the collections devoted especially to moralized natural history may be mentioned the *Bonum universale de apibus* of Thomas of Cantimpré, a Belgian Dominican, written between 1245 and 1263, in which the peculiarities of bees are explained in an allegorical manner; and the *Formicarius* of John Nyder (d. 1458), a Dominican of Swabia, in which the ant plays the part of the bee in the work just mentioned above. Similar works by Neckam, John of Sangeminiano and Bartholomew, incorrectly called Glanville (a Franciscan, born probably in England, who lived in France and flourished between 1226 and 1248), enjoyed great popularity and are often cited in sermons.

Besides the above collections of *exempla*, with or without moralizations, there are certain systematic treatises for the use of preachers which contain large numbers of *exempla*. The earliest and most interesting is the work of Étienne de Bourbon, a Dominican of the thirteenth century, whose work, usually known as the *Liber de septem donis Spiritus Sancti*, has been partially edited by A. Lecoy de la Marche for the Société de l'histoire de France. Other works of this class are the *Liber de abundantia exemplorum*, attributed without reason to Albert the Great; the *Summa virtutum ac vitiorum*, by William Perrault, who died about 1475; Holkot's treatise on the wisdom of Solomon (*Opus super Sapientiam Salomonis*); and the most extensive and important work of this class, the *Summa Prædicantium* of John Bromyard, an English Dominican who died in 1418.

The influence of the above-mentioned collections of Latin *exempla* had a profound influence upon the vernacular literatures: some of the Latin collections were translated in their entirety, as was the case with Étienne de Bourbon, already cited, but generally the similar works in the modern languages of Europe are imitations and not translations. The most extensive of these are the Spanish *Libro de los Enxemplos* (beginning of the fifteenth century), published in the *Biblioteca de Autores Españoles*, an alphabetical collection, probably a translation, although the original has not yet been discovered, and the Catalan collection mentioned above. There are brief collections in Portuguese, Italian, French, and English, which can not be mentioned in detail here.

The collections above described contain an immense amount of material of all kinds, historical anecdotes, fables, apologues, legends, jests, popular tales, etc. Their value consists partly in the light they throw upon the history of mediæval culture, but more especially in the important part they played in the diffusion of popular tales (fables, jests, etc.). The Oriental elements brought from Syria by Jacques de Vitry and others were spread throughout Europe by the host of preachers who incorporated them into their sermons.

A full account of the use of *exempla* in sermons and of the collections for the use of preachers, as well as the imitations in the various modern languages of Europe, may be found in the introduction to *The Exempla or Illustrative Stories from the Sermones vulgares of Jacques de Vitry* (London, 1890, Folk-lore Society), by the writer of this article. T. F. CRANE.

Exemplary Damages: See DAMAGES, MEASURE OF.

Exequa'tur: See CONSUL.

Exercise [viâ Fr. from Lat. *exerci'tium*, from *exerce're*, *exer'citum*, to drive along, to busy]: activity of any part of the body having for its essential object the attainment or maintenance of a healthy degree of activity of the vital processes. So important is it to the development, growth, and sustenance of bodily and mental vigor that it is instinctively sought, and from time immemorial various games, sports, and similar measures, together with a vast number of mechanical devices, have been devised to provide it. It is a curious circumstance that there are comparatively few pleasures which do not necessarily involve activity either of body or of mind.

Exercise may be active or passive: active, when directly due to volitional effort; passive, when neither mind nor body takes active part, as when obtained by massage, electricity, or similar means practiced by another individual or by purely mechanical devices. The various forms are differently directed: some to the mind, as study, composition, chess, etc.; others to the body, as dumb-bells, Indian clubs, rowing, walking, etc.; and others both to mind and body, as in games such as lawn tennis, cricket, etc., which demand mental and physical decision and skill. Its importance to the healthy development and maintenance of both mind and body is becoming more and more appreciated, especially in respect to systematic physical exercise by those whose time is largely spent in mental labor; and instruction of this character is fast assuming a necessary part of the curricula of the leading schools, colleges, and universities. The old idea that a man can not be an athlete both in mind and body can no longer be accepted, while, on the other hand, it can not be denied that the vigor of the mind is increased by greater vigor of the body. Exercise to afford the most benefit should be conducted systematically; it should last for short periods at first, and then gradually be increased from day to day; it should be directed to those parts of the organism that most need it, and it should not be persisted in beyond a stage of slight fatigue. It is perhaps needless to state that the brain worker needs physical exercise and the bodily worker mental exercise, but it must not be forgotten that the former rarely uses all of his faculties in his labor, and that in the work of the latter only a few parts of the body may be involved. The cardinal principles in the adoption of any form of exercise are to select those which are specially directed to such parts as are, because of peculiar vocations, but little or rarely used, or to portions of the system which for some reason are illy developed, and to choose those which, other things being equal, are most agreeable to us, and which by experience yield the most good.

Where certain groups of muscles or individual muscles are weak the Swedish system of gymnastics will be found especially available. By this method the muscles are exercised systematically by compelling them to work against proper forms of resistance. Massage and electricity are also of great benefit in these cases, particularly the former, in which the muscles are pressed, pounded, kneaded, rubbed, or stroked. Such exercise favors the supply of blood to the parts, stimulating them to healthy activity and carrying away effete and detrimental waste products that tend to accumulate when the tissues are sluggish.

Nearly all forms of exercise are more beneficial if procured in the open air, and especially when the body is free from unnatural restraint by clothing. In all forms of physical exercise women should avoid wearing corsets or other articles of apparel that restrain free movements of the body or hinder in any way absolute freedom of the circulation.

Parts of the body long subjected to disuse become enfeebled, degenerated, and finally functionless. Fish kept in caves from which light is excluded soon lose their power of vision, successive generations are born blind, and after a time the offspring are born with very imperfect or even rudimentary eyes.

See PHYSICAL EDUCATION, SPORTS, ROWING, BASEBALL, FOOTBALL, LAWN TENNIS, etc. EDWARD T. REICHERT.

Exeter (in Lat. *Isca* or *Exonia*): city and seaport; capital of Devonshire, England; on the river Exe, about 10 miles from the sea, and 170 miles W. S. W. of London, with which it is connected by railway (see map of England, ref. 14–E). It is pleasantly situated on the sides and summit of an acclivity, and is well built, well paved, and liberally supplied with water. It was the *Isca Damnoniorum* of the Romans, and the coins, pottery, sepulchral urns, etc., which have been found there show that it was a place of some importance. At the time of the Saxon conquest it was not deserted by the British. When Athelstan arrived there, in 926, he found it occupied by Britons and Saxons in common. William the Conqueror appeared before the city in 1068; he founded the castle of Rougemont. Exeter is the see of a bishop, and has a magnificent cathedral, which was commenced in 1280; it is 408 feet long, and has two Norman towers 145 feet high. The W. front is richly decorated, and presents a façade which is one of the most beautiful in England. In one of the towers is the Great Tom of Exeter, or Peter's bell, which weighs 12,500 lb. Exeter contains a theater, twenty-four Episcopal churches and chapels, and an asylum for lunatics. It returns one member to Parliament. Vessels of 400 tons can ascend the Exe to this place, from which dairy produce, fruits, and other articles are exported. Exeter has several nurseries, and was at one time the center of a considerable woolen trade. In the middle of the eighteenth century the value of its annual export of woolen goods amounted to half a million dollars, and was exceeded only by that of Leeds. Its trade, though still flourishing, is now of a miscellaneous description. Pop. (1901) 47,180.

Exeter: town (founded by Rev. John Wheelwright in 1638); one of the capitals of Rockingham co., N. H. (for location of county, see map of New Hampshire, ref. 10–G); on the Squamscott river and on the Boston and Maine Railroad; 50 miles N. of Boston. It has 8 churches, the Phillips Exeter Academy (a richly endowed institution founded in 1781), the Robinson Female Seminary, 9 schools, a high school, a large cotton-mill, a machine-shop, one of the largest shoe-factories in New England, and manufactures of shoemaking-machinery, grist-mill supplies, pottery, lumber, castings, and carriages. During the American Revolution Exeter was the capital of the State and a center of military operations. Pop. of township (1880) 3,569; (1890) 4,284; (1900) 4,922. EDITOR OF "NEWS-LETTER."

Exile [from Lat. *exsi'lium*, *exi'lium*, deriv. of *exsul*, *exul*, an exile; etym. uncertain]: the condition of a person who either voluntarily or by penal sentence absents himself from his own country in order to escape the consequences to life, liberty, or property that residence at home would bring with it; also, the person who so absents himself. The Greeks in their usages and legislation were familiar with voluntary exile on account of involuntary homicide, with ostracism, a political contrivance, especially at Athens, in order to get rid of a powerful party-leader, and with exile especially for life. In the two former cases a man retained his property, and return to his native land was allowed; in the last, besides lifelong absence, he suffered the ills of confiscation of his goods. At Rome, while the republic lasted, a person, before sentence for crime, could go to a foreign country; and there were even treaties with certain states by virtue of which Romans, and *vice versa* citizens of such states, had a liberty conceded to them of living in exile in each other's country. Verres and Milo, with many others, thus left the Roman dominions to escape a sentence. Exile was also a penalty for certain crimes, or, as in the case of Cicero, was decreed by vote of the comitia. It was called *aquæ et ignis interdictio*—i. e. prohibition from the use of fire and water within certain limits. Under the empire the forms of exile in use went by the names of *relegatio* and *deportatio*. Relegation either excluded the person affected by it from a particular place or territory, or it required him to reside at a particular place or within a particular country, without depriving him of property, citizenship, or a father's power, and did not necessarily prevent his return. Deportation, called also deportation to an island, was introduced under the emperors, and involved loss of citizenship and of property. The poet Ovid was relegated, under Augustus and by an edict, to Tomi in Lower Mœsia, where he died after ten years of exile.

Exile is as a punishment unknown to English law, unless it be in the form of transportation by act of Parliament, or as a condition of release by the executive from a capital or other severe punishment.

Free countries, unless overawed by superior power, have generally given refuge to political exiles, and seldom have they delivered them up on demand from the exile's country. (See ASYLUM.) This was the boast of Athens, which Demosthenes calls the common place of refuge for Greece; he also pronounces it to be the common usage of all men to give shelter to an exile. The connection of the exile with his native land of course ceases. The jurisdiction over him depends on the laws of the land where he is domiciled. If, as sometimes happens, he engages in plots with accomplices in his native country, he is amenable to the law of his domicile for any criminal acts he may commit within its jurisdiction. Such a person is sometimes demanded by the authorities of his original home, in order to be proceeded against by its laws and modes of trial. But a free country will refuse to surrender its territorial rights in such cases. See EXTRADITION.

Exmoor Forest: a district of England, partly in Devonshire and partly in Somersetshire; mostly uncultivated, and occupied by dark ranges of hills and lonely valleys. The surface rocks are Devonian slate and new red sandstone. The highest point of the hills is 1,668 feet. Exmoor is partly covered with heath, and contains considerable meadow-land. It gave name to a breed of sheep, now nearly extinct. Area, 19,270 acres. Ponies are bred extensively, and iron is mined.

Exmouth: a town and watering-place of Devonshire, England; on the English Channel at the mouth of the Exe; 10 miles S. E. of Exeter (see map of England, ref. 14–E). The mildness of the climate and the beauty of its scenery render it a favorite place of resort. The fisheries and lace-making are the principal industries. Here Sueno the Dane landed in 1003. Pop. (1891) 8,097.

Exmouth, EDWARD PELLEW, Viscount: admiral; b. at Dover, England, Apr. 19, 1757. He served with distinction at the battle of Lake Champlain in Oct., 1776, and became a post-captain in 1782. In 1804 he obtained the rank of rear-admiral, and in 1808 that of vice-admiral of the blue. He was created Baron Exmouth in 1814, and was raised to the rank of admiral. He commanded a fleet which in 1816 was sent to enforce a treaty which the Dey of Algiers had violated. This fleet, aided by a Dutch fleet, bombarded Algiers in August of that year, and reduced the dey to submission. Exmouth received the title of viscount in Dec., 1816. D. Jan. 23, 1833. The title is extant, and in the Pellew family.

Ex'ner, FRANZ: philosopher; b. in Vienna, Aug. 28, 1802; became in 1831 Professor of Philosophy in the University of Prague, and was appointed counselor in the Austrian Ministry of Public Education in 1848. He wrote, among other works, *Die Psychologie der Hegel'schen Schule* (1842–44) and *Ueber die Lehre von der Einheit des Denkens und Seins* (1845). D. in Padua, June 21, 1853.

Exodus [from Gr. ἔξοδος, a going out; ἐξ, out + ὁδός, way]: the migration, whether by compulsion or otherwise, of any considerable body of people, as of the Moors from Spain in 1492, of the Huguenots from France after the Revocation of the Edict of Nantes in 1685, or of the Irish to the U. S. since 1847. The term is commonly applied, however, almost exclusively to the departure of the Israelites from Egypt under the leadership of Moses. The 400 years of the affliction in Egypt (Gen. xv. 13, Acts vii. 6) is doubtless a general expression, equivalent to the more specific 430 years of Ex. xii. 40, 41. But did this 430 years begin when Jacob went into Egypt, or was some other well-known event, Abraham's migration to Canaan, for instance, taken as the starting-point? The latter would be quite consonant with the Bible usage in other passages—e. g. Jud. xiv. 17, cf. 14; Num. xiv. 33, cf. Deut. ii. 14. The Septuagint translators (Ex. xii. 40, 41), the apostle Paul (Gal. iii. 17), and Josephus (*Ant.* ii. xv. 2, cf. ii. ix. 1, and *Wars* v. ix. 4) all interpret the 430 years as beginning with the migration, thus making the time of the actual sojourn 215 years. This is confirmed by Gen. xv. 16: "In the fourth generation shall they come hither again." The coming hither would be after the forty years of the exodus, added to the period of the sojourn. According to the Bible genealogies, the sons of Moses or Aaron who entered Canaan were of the fourth generation from the grandchildren of Jacob who came to Egypt (Ex. vi. 18, *seq.*). Bezalel's sons were of the seventh generation (1 Chron. ii. 3–20), and the daughters of Zelophehad of the sixth (Num. xxvi. 28–33), and the sons of Joshua, the son of Nun, of the tenth or eleventh (1 Chron. vii. 22–27), though there is here some uncertainty as to the meaning. All these are consistent with the idea of a period of 255 years, and inconsistent with that of a period of 470 years. Against this it is urged that 215 years is too short a time for the Israelites to have become so numerous as they were at the exodus. But the Bible does not represent that they were all lineal descendants of Jacob. It mentions by name "seventy souls" (Gen. xlvi. 7–27), but intimates that, in addition, those who came with Jacob were a great multitude (Gen. xii. 5, xiv. 14, xxvi. 16, xxxvi. 7, etc.). These were all participants in the covenant of circumcision (Gen. xvii. 12, etc.), and others might become so (Ex. xii. 48). Further, as Malthus says, it has been constantly remarked that all new colonies, settled in healthy countries, where room and food were abundant, have constantly made a rapid progress in population. Egypt, it is well known, was famous among the nations of antiquity not only for its animal fecundity, but also for the fertility of its human occupants. And yet the rapid increase of the Israelites in Egypt is emphasized in the history, and referred to afterward (Ps. cv. 23, 24), as something extraordinary. On the whole, it seems to be well established that the period of 430 years dates from the migration, though this is doubtless contrary to the opinions now most prevalent.

As to the points of contact between Egyptian and Hebrew history, the time has not yet come for final conclusions. Egyptian history itself is undergoing reconstruction. It may be regarded as settled that the Pharaohs of the exodus were those of the nineteenth dynasty, and that the Pharaoh of Abraham was one of the shepherd kings. It is now generally assumed that the Pharaoh of Joseph was Apophis, the last of the shepherd kings, but this is certainly at variance with Gen. xlvi. 34, xlvii. 22, xli. 45, etc. Probably the shepherd kings had lost their supremacy as early as Isaac's time (Gen. xxvi. 2). Jacob's Pharaoh may have been Thothmes III. or some other king of the eighteenth dynasty.

The Israelites dwelt principally in the Delta. Several biblical sites have been identified there by recent explorers. Opinions differ as to whether they crossed the Red Sea near the present site of Suez, or further north, near the Bitter Lakes. From Suez to Sinai the distance is about 150 miles. Their route to Sinai was probably through the Wadi Feiran. Kadesh Barnea, the point at which they first touched the borders of Palestine, and to which, after thirty-eight years of penal wandering, they returned, has been identified on the west side of the desert. If the Israelites were to be civilized by contact with another people, no better place could have been found, and on the whole no safer, than Egypt. The miracles by which they were delivered, and which attended them all the way through the desert until they were finally planted in their former home, made a profound impression upon the national character.

The date of the exodus, in years of the Christian era, is a matter of conjecture. Usher places it about 1490 B. C. A more correct computation from the Bible numerals might make it some decades earlier. The date now most commonly received is about 1320 B. C., but this is in conflict with the Bible statements, and is based on really very slight evidence. WILLIS J. BEECHER.

Exodus, The Book of: the second book of the Old Testament; so named by the Alexandrian translators of the Old Testament. The Hebrews of Palestine designated it by its opening words, *Elleh Shemoth*, "These are the words." It consists of two distinct portions; the former (chaps. i.–xviii.) describing the deliverance of the Israelites from Egypt; the latter (chaps. xix.–xl.) describing the giving of the law. Its Mosaic authorship is affirmed by tradition and attested by evidence, but denied by many eminent scholars. See HEXATEUCH. Revised by WILLIS J. BEECHER.

Exogamy: See ETHNOLOGY.

Exogenous (eks-oj'ĕe-nŭs) **Plants**, or **Ex'ogens** [from Gr. ἔξω, without + root γεν-, become, grow]: plants in which the growth of the stem is in concentric layers between the pith and the bark. See DICOTYLEDONS.

Exophthalmic Goitre: See BASEDOW'S DISEASE.

Ex'orcism [from Gr. ἐξορκισμός, deriv. of ἐξορκίζειν, to administer an oath, (in Eccles. Gr.) to drive out by adjuration; ἐξ, out, + ὅρκος, oath]: a ceremony designed to expel demons or evil spirits from persons, places, or things. Exorcisms of various kinds have been practiced from remote antiquity in nearly all nations and races. The ancient Jews, according to Josephus, the Talmud, and the New Testament, had a class of persons professing to be skilled in casting out devils. In the early ages of the Church a separate class of exorcists arose who claimed special powers of controlling evil spirits. Many ceremonies were instituted by them, and their powers were exerted not only over those possessed by the devil, but over all candidates for baptism, over the baptismal water, and other sacred things and places. In the Church of Rome there is a special order of exorcists—one of the four orders of the minor clergy. All persons in superior orders must pass through this degree. In the Greek Church a similar order exists. Exorcism is obsolete in all Protestant denominations, though formerly recognized in several.

Exosmose: See LIQUID DIFFUSION.

Exoteric: See ESOTERIC.

Exosto'sis [Gr. ἐξόστωσις, a diseased excrescence on the bone; ἐξ, out + ὀστέον, bone]: an abnormal outgrowth from one of the bones of the skeleton. In man the disease especially seats itself upon the femur or on some of the bones of the skull. In the latter case it sometimes assumes a peculiar ivory-like character (eburnized exostosis), from the presence of an excess of calcium phosphate. It is usually developed from an inflammatory exudate, and is ordinarily formed with the exact structure of true bone. The disease is commonly painless. Some classes arise from a syphilitic taint, others from a rheumatic or gouty diathesis, others from various forms of irritation.

Some writers include bony outgrowths among the tumors, but it is best to regard as tumors only the apparently causeless bony masses that occur about bones or elsewhere. Ordinarily the only cure is in ablation.

Revised by WILLIAM PEPPER.

Expansion [from Lat. *expan'dere*, *expan'sum*, spread out]: a spreading out; an increase of bulk or extent, especially under the action of internal forces. In physics the term is sometimes applied to mere increase in length (more properly, elongation or dilatation), sometimes to superficial expansion, but most frequently to increase of volume. An important cause of expansion is rise of temperature, although there are important exceptions to the law, as in the case of vulcanized rubber, of iodide of silver, of water between 0° and 4° C., of the oxide of copper and the diamond at low temperatures, and of iron above a red heat. Elongation per unit of length, when a body is heated one degree centigrade, is its coefficient of *linear* expansion; increase of bulk per unit of volume, when a body is heated one degree, is the coefficient of *cubical* expansion. The observed expansion of a liquid or gas within a containing vessel, on heating or cooling, is termed its *apparent* expansion. The *true* expansion of the fluid is obtained by correcting for the changed expansion of the vessel.

In the case of homogeneous bodies, heated uniformly, expansion takes place in all directions equally. The result is change of volume without change of form. In crystals other than of the "regular" system, and in all bodies or systems not homogeneous, expansion will not be the same in all directions, and change of form will accompany every change of temperature. The expansion of wood, for example, is greater across the grain than with it. In extreme cases (where two materials of very different coefficients are rigidly combined) the deformation on heating and cooling or under change of pressure may be so marked as to afford a means of measuring temperature or pressure. See THERMOMETER; also BAROMETER (aneroid). E. L. NICHOLS.

Expatriation [from Lat. *ex*, out of + *patria*, native country]: the voluntary abandonment of one's native country with the intention of becoming a citizen of another state. The right of a person to throw off the obligation of allegiance has been denied by eminent writers and some governments. The true view would seem to be that the power to determine when the allegiance of the citizen may cease belongs to the state of which he is a member, rather than to himself. At the same time the freedom of intercourse between nations in modern times and the interests of civilization require that the various nations should provide liberal rules by which at proper times the relation of the citizen to the state may cease, and the individual, freed from the ties of burdensome allegiance, may assume another citizenship if he so desire. In this spirit may now be found statutory declarations by leading states on this subject, as well as treaty stipulations. In the act of the U. S. Congress of July 27, 1868, § 1, it is recited that the act of expatriation is a natural and inherent right of all people, and it is enacted that any declaration or instruction or decision of any officer of the government which denies, restricts, or questions the right of expatriation is inconsistent with the fundamental principle of the government. In the United Kingdom, by 33 Vict. ch. 14, § 6, subjects in general cease to be such upon becoming naturalized in a foreign state. The laws of the various nations upon this subject are collected under the direction of the U. S. Government in a publication entitled *Opinions of the Principal Officers of the Executive Departments, and other Papers, relating to Expatriation, Naturalization, and Change of Allegiance* (Washington, 1873).

If the right of expatriation be admitted except in certain cases, such as where the person holds a public trust, or is liable to do military service, or is charged with crime, a question of practical difficulty remains as to the mode in which his election to abandon his citizenship shall be evidenced. In some countries—e. g. France and Prussia—it may be shown by the fact that the person has taken his domicile in a foreign country in such a sense that he has abandoned all intent to return to his former home. This rule is not very satisfactory, for questions of domicile are frequently very difficult of solution, as they depend upon a judicial inquiry into the intent of the party, and this in turn depends upon an examination into a great variety of circumstances, often ranging over many years. A much more convenient test is that of the British statute already cited. This provides that naturalization in a foreign country shall be evidence of an intent to renounce British citizenship. Should the former subject wish at any time to resume his relations with the United Kingdom, he can be naturalized under the laws of that country. The subject of expatriation is not so important in the domain of private law as it was formerly, when aliens were subject to serious disabilities. See ALIEN, NATURALIZATION, INTERNATIONAL LAW, and CITIZEN.

Expectorant [from Lat. *ex*, out of + *pec'tus, -oris*, breast; Lat. *expectora're* is used only in sense of banish from the mind]: a medicine which facilitates or causes the discharge of mucous secretions from the air-passages within the chest. Many balms, gums, and nauseating medicines, as well as demulcents and other drugs, are reputed to have expectorant properties. Some medicines not usually considered expectorant appear to stimulate the secretions of mucus in the air-passages, as ammonium chloride (sal-ammoniac) and potassium hypophosphite. Among the most useful expectorants are ipecac, squill, lobelia, and blood-root. These are also emetics, sedatives, and diaphoretics.

Expectoration: the act of expelling fluid or semifluid matters from the lungs and air-passages by coughing and spitting; also, the matters so expelled. The characters of the expectoration are of great importance to the physician in discriminating between various diseases. The general appearances of the sputum have lost somewhat in value as indications of different diseases, since the science of physical diagnosis and microscopic examination have made possible much more accurate means of diagnosis, but in ordinary practice the physician is still to a large extent guided by the nature of the expectoration. In ordinary "colds," or bronchitis, there is usually a somewhat frothy, mucous expectoration, becoming more yellow and purulent toward the end, but at no time of absolutely distinctive character. In the early stages of pneumonia, when the lungs are engorged with blood, small hæmorrhages are apt to occur and give to the sputum a quite distinctive "rusty" appearance. Sometimes in similar conditions of congestion of the lungs, not pneumonic, rusty sputum may occur, but in the great majority of cases pneumonia is indicated. In consumption a variety of appearances may be presented according as the disease takes one form or another; but in slow, chronic cases, and less constantly in other forms, a peculiar kind of sputum is seen. In this form occur rounded masses of yellow, purulent appearance, which do not break up, but remain as clumps when received into water, and from the peculiar appearance the name "numular," or coin-like, has been applied. In gangrene of the lungs the sputum is peculiarly offensive; in abscess it is composed of pure pus. The latter condition may also occur when abscesses in other localities, as the liver, spleen, pleural cavities, etc., break through the lung to be discharged.

The expectoration when lying in the bronchial tubes acts as an irritant, thereby causing cough and its own discharge. It is therefore not usually advisable to employ medicines to check cough, but rather to so alter the character of the secretions as to make expectoration easy. If, from the irritable condition of the bronchial mucous membrane or other cause, excessive cough be provoked, it may become necessary to apply remedies to lessen the cough. This is especially desirable when, as in old persons or the debilitated, the strength is being exhausted by constant effort.

The microscopical examination of the sputum has become of very great importance, since the means of discovering the bacillus of tuberculosis and other micro-organisms have made it possible to reach a positive diagnosis in this way. Sometimes, indeed, an incipient case of consumption may be detected before any auscultatory signs or general symptoms would indicate the onset of the disease. At the same time, the occurrence of the bacilli in the expectoration, and a knowledge of the contagiousness of consumption, point out one of the means of dissemination of the disease, and indicate, as a means of prevention, the destruction of the germs in the sputum by receiving this at once into antiseptic solutions, and, above all, preventing expectoration upon floors or carpets where the sputum may be subsequently dried and spread in the air as dust. Another micro-organism now recognized as the cause of disease, and readily demonstrated in the sputum, is the pneumococcus, or the germ of pneumonia; but its recognition is of much less practical value than that of the tubercle bacillus. WILLIAM PEPPER.

Expert Testimony and **Expert Witnesses**: See the Appendix.

Expiration [from Lat. *exspira'tio*, deriv. of *exspira're*; *ex*, out + *spira're*, breathe]: in physiology, the operation or movement by which the air that has been changed by the respiratory process is expelled from the lungs. This movement is effected partly by the elastic contraction of the lungs and the walls of the chest, which were dilated by the act of inspiration, but the resiliency of the chest-walls is greatly assisted by the action of numerous muscles, especially in forcible expiration. See RESPIRATION.

Exploits, River of: a river of Newfoundland; traverses nearly the whole breadth of the island from S. W. to N. E. It is navigable for steamers 12 miles to the rapids, and above these small boats can go to within 50 miles of the southwest coast. Its valley is level, well timbered, and abounds in game and fish, but has few inhabitants. This valley is known to contain much arable land.

Explosion [from Lat. *explo'sio*, deriv. of *explo'dere*, *explo'sum*, drive off the stage by clapping or making a noise; *ex*, out + *plau'dere*, clap the hands, stamp the feet]: a bursting with a loud report; in physics, the sudden and violent expansion of the parts of a body, caused by heat or chemical affinity. Explosions are often caused by the elastic force of steam confined in boilers, etc. The explosion of gunpowder is the result of the sudden formation and expansion of gases, into which the powder is converted by chemical agency. This term is also applied to the violent eruption or discharge of a volcano. Humboldt heard the explosion of Cotopaxi at the distance of 130 miles.

Explosives: compounds practically available in war, in mining, and in general use for the sudden development of immense force. They may be classified conveniently as nitrate mixtures, of which gunpowder is the familiar type; nitro-compounds, including guncotton and nitroglycerin, together with their very numerous derivatives; chlorate mixtures; picrate mixtures; and, lastly, the class of fulminates—chiefly useful as detonators.

Gunpowder, which was first employed in war about the year 1350, is the oldest and most generally useful of these agents. It is a mechanical mixture of potassium nitrate, carbon, and sulphur, in proportions usually varying but little from 75, 13, and 12 respectively. Purity is essential to excellence. The operations of its manufacture consist, in general terms, in very finely pulverizing the ingredients, thoroughly incorporating them, compressing them into a cake, granulating it, separating the different sizes of grain by sieves, glazing, drying, and finally removing all dust by the use of fine sieves.

In the storage of gunpowder special precautions against fire and moisture are needed. A spark, friction between hard bodies, or a temperature raised suddenly to 572° F., determines an explosion; while slight moisture, which may readily be absorbed from damp air, produces caking and deterioration. A wetting is permanently destructive to the compound. Frost produces no injurious effects, either temporary or permanent.

As gunpowder is a simple mechanical mixture, its properties may readily be varied to suit the requirements of a quick-burning or a slow-burning explosive. Its expansive power is due to two distinct causes—the sudden transformation from a solid to a gaseous form of vastly greater volume, and the heat developed by the chemical change, which induces enormous tension. It is apparent therefore that a variation in the relative proportions and condition of the ingredients, by changing the chemical products of the explosion, must affect the expansive force; and also that a similar result may be obtained by mechanical means directed to modifying the duration of the time required for combustion.

It is to a skillful application of the last method that some important improvements in gunpowder designed for heavy ordnance are due. Gen. Rodman, of the U. S. army, inaugurated a series of experiments directed to this end in 1856, and from the results of his labors the U. S. was provided in advance of European nations with an explosive suited to modern cannon. His mammoth and perforated-cake powders—the former consisting of large irregular grains, tested by two standard sieves of six-tenths and nine-tenths of an inch respectively, and the latter of hexagonal or cylindrical cakes perforated by holes—have been copied in the English pebble and pellet, and the Russian prismatic powders, by the aid of which some important improvements in artillery have been rendered possible. Pebble powder is simply pressed cake, broken into large irregular pieces and glazed. Pellet powder consists of mealed powder compressed into small blocks, of regular and sometimes indented forms, and of dimensions varying for different calibers. Prismatic powder consists of mealed powder compressed into flat, perforated cakes of hexagonal form, about an inch thick and an inch and a half on the longest diagonal. This subject is still undergoing investigation; the facts having been developed that the time of burning, and hence the strain upon the gun for a given initial velocity in the projectile, may be modified by varying the size and form of the grains, their density and hardness, and the mechanical condition of the exterior.

The next advance in the development of gunpowder was made by modifying the carbon ingredient. By replacing one-third of it by uncarbonized peat, Gen. Oliver, in 1874, was manufacturing in the U. S. a variety which when well rammed gave a higher initial velocity, with less recoil and less smoke, than the older grades, by reason of its slower rate of burning. Its color was a clear brown. Following the same line of research, brown prismatic or cocoa powder was introduced in Germany in 1882, and it soon attracted widespread attention. The carbon consisted of slightly carbonized straw; the rate of burning was much less than with black powder, giving a lower initial but a longer sustained pressure. Cocoa powder is manufactured in the U. S., the carbon consisting of about two parts of baked wood, retaining its fibrous structure, and one part of a carbohydrate, as sugar. The proportions are varied according to the grade desired. The rate of combustion at first is slow, but it increases as the grains break up, thus tending to equalize pressure throughout the bore of the gun. For further information on this subject see GUNPOWDER.

The maximum pressure of exploded gunpowder, unrelieved by expansion, has been investigated by various parties, whose results range from 7 tons to 662 tons to the square inch, the latest authorities indicating about 40 tons.

The difficulty of obtaining saltpeter in large quantities, and hence its cost, has induced many attempts to replace it by other nitrates, such as those of sodium, lead, and barium; but although good blasting powders have been thus prepared, none suited to propelling purposes have been obtained. Mixtures containing ammonium nitrate, however, have attracted attention; in part because, although objectionable from its deliquescent tendency, this salt yields only gaseous products, and hence may form the basis of a class of "smokeless" powders of which Chilworth special is the best-known type. In combination with di- or trinitrobenzole and other ingredients, it also forms bellite, roburite, and securite, which have been used in shells and commercially. They are claimed to be "flameless," and hence specially suited for use in mines dangerous from fire-damp.

Guncotton.—In 1832 Braconnet discovered that by dissolving starch in nitric acid, and adding water, a white explosive substance was precipitated, to which the name xyloidin was given. A little later, Pelouse obtained a similar compound by treating paper, or cotton or linen fabrics, with nitric acid, and named it pyroxilin. These were the precursors of guncotton, which was discovered by Schönbein in 1846, and at once excited much attention as a possible substitute for gunpowder. Adverse official reports, however, were soon made in France, the U. S., Germany, England, and Austria, and the explosive fell into general disfavor on account of its liability to spontaneous explosion, its corroding residua, and its excessively violent and irregular character, all of which unfitted it for most military uses. Baron von Lenk, a member of the Austrian commission, was not so readily discouraged. He continued a series of experiments for several years, which ultimately led to so great improvements in manufacture that in 1853 he was able to construct a successful twelve-pounder battery employing guncotton. This led to its temporary introduction into the Austrian military service, and again attracted the attention of foreign nations to the new explosive.

Baron von Lenk's system consisted in cleansing the long-staple variety of raw cotton in an alkaline wash, followed by one in pure water; thoroughly drying it; steeping it for forty-eight hours in a cold mixture of strong nitric and sulphuric acids—one part of the former to three parts of the latter by weight; freeing the resulting trinitrocellulose from the acids by a centrifugal machine, by thorough rinsing, and finally by the action of running water for a period of six or eight weeks, alternated with a boiling potash bath and hand-washing; air-drying it; rinsing it in a hot solution of potassium silicate to retard the rapidity of combustion; and, lastly, again washing and thoroughly drying it. He partially regulated the suddenness of explosion by twisting the guncotton into ropes or weaving it into cloth to secure a more uniform density. Musket cartridges were formed by wrapping the thread around wooden plugs, to prevent unequal ramming. An admixture of a certain proportion of ordinary cotton was also employed to reduce the violence of action.

In 1863 Mr. Abel, as a member of a committee appointed by the British War Office, undertook an experimental investigation into the merits of this system, and succeeded in materially improving it. Instead of the costly long-staple cotton, he employs ordinary cotton waste, which is treated with the mixed acids, one part of nitric to three of sulphuric by weight, without any preliminary process except careful drying. It is then rinsed in a large volume of water, and dried by a centrifugal apparatus three or four times. Next it is placed in a pulping engine, like those commonly used in the manufacture of paper, and reduced to a state of fine subdivision. It is then transferred, in quantities of at least 10 cwt., to a poaching-engine, where it is beaten for about forty-eight hours until it remains uniformly suspended in a large volume of warm water, continually renewed, and finally rendered slightly alkaline. It is then dried in a centrifugal machine, and molded into disks of the desired form and dimensions, which receive a pressure ranging from 4 to 6 tons per sq. inch. Up to this point the guncotton has been in a damp, and consequently entirely safe, state, and if desired it may be so stored for an indefinite period of time without losing its peculiar properties. To prepare it for use it is dried upon hot plates, freely open on every side to the air. This system of manufacture is the best known, and yields a product both uniform and safe.

In appearance, Abel guncotton consists of regular cylinders, of dimensions varying with the use proposed. It is white in color, hard to the touch, and sinks readily in water. Ignited, unconfined, by a flame, it burns with a strong blaze. Fired by a detonating fuse, or raised to a temperature of about 340° F. in a strong case, it explodes with great violence, a single ounce being sufficient to indent a plate of iron or disrupt a thin slab of stone upon which it is loosely laid. The character of the detonation varies with the fulminate employed, being most sudden with fulminating mercury. Even in a damp state, containing 20 per cent. of moisture—it may be exploded without much loss of power by a disk of dry guncotton in contact. It is believed, upon good grounds, to be free from danger of spontaneous explosion. Several governments have adopted it as the explosive best suited to submarine warfare, and have accumulated large quantities in store.

Guncotton produces little smoke, and leaves a very small residuum of solid matter, the chief products of combustion being carbonic oxide, carbonic acid, water, and nitrogen. It is unalterable in water, no matter how long submerged. It contains about 2 per cent. of moisture in its normal condition, and even when exposed to ordinary damp air it absorbs but little more—a property which gives it a great advantage over gunpowder. Chemically, the purest guncotton may be regarded as cellulose, in which three atoms of hydrogen are replaced by three molecules of peroxide of nitrogen. Thus constituted, it is insoluble in mixtures of ether and alcohol. If, however, great care has not been observed in the manufacture, less simple compounds are formed, which may readily be dissolved in these mixtures, forming collodion, much used in photography and the arts.

Guncotton does not contain sufficient oxygen to consume its carbon completely, hence some nitrate is often added to supply the deficiency. In mining this is beneficial, for the further reason that it tends to lessen the formation of a poisonous gas, carbonic oxide.

In the studies to produce a "smokeless powder" much attention has been given to nitrocotton. Trinitrocellulose treated with acetone or certain other solvents, either in a liquid or gaseous form according to the object in view, becomes plastic, and may then be either strongly compressed into sheets or plates or be forced through dies to form cords; and thus be subdivided into grains of the size required. After the evaporation of the solvent the organic structure seems to have been destroyed, leaving a dense amorphous mass incapable of detonation and exploding with but little smoky residue. Munroe's new smokeless powder, which is meeting with favor in the U. S. navy, contains trinitrocellulose as an important ingredient.

Schultze Powder.—The conversion of lignin or wood-fiber into an explosive similar to guncotton was attempted soon after the discovery of that compound, especially by Capt. Schultze, acting for the Prussian Government. His method consisted in soaking the wood—preferably alder—in water, to give it toughness, cutting it by fine saws into a kind of cross-grained veneering, and subsequently punching it into small cubes, of which the size varied with the use for which the powder was designed. The grains thus produced were boiled in a solution of soda, and afterward alternately exposed to steam and washed in a solution of chlorine to free them from resins, etc. They were next treated for several hours with mixed nitric and sulphuric acids, kept cool by constant stirring, and afterward were thoroughly washed and dried. In this state the powder is but slightly explosive, and it may be kept in store indefinitely. For use the grains must be submerged for about twenty minutes in a solution of nitrate of potassa and baryta, and then carefully dried and sifted. The necessary oxygen having been now supplied, the powder has a high explosive power. It burns with but little solid residuum or smoke, and is said to be both cheaper and stronger than common gunpowder, weight for weight. It, however, readily attracts moisture, is liable to form dust by attrition, and is more bulky than gunpowder, in the proportion of 3 to 1.

Nitroglycerin, or *glonoin oil*, was discovered in 1847 by Ascagne Sobrero, but remained unapplied to practical uses until 1864, when Alfred Nobel, a Swedish engineer, began to develop its industrial value. Since then it has been largely employed upon the continents of Europe and America. It is prepared by the action of a mixture of concentrated nitric and sulphuric acids upon glycerin introduced drop by drop. At ordinary temperatures it is an oily liquid, usually colorless if made from good glycerin, but sometimes discolored by causes not well understood. It has no odor, and is of a sweet and slightly pungent taste. It is highly poisonous, even short contact with the skin being sufficient to produce severe headache. Its specific gravity is 1·6. When first made it has a milky appearance, which ultimately disappears. Nitroglycerin incompletely freed from the acids undergoes spontaneous decomposition, is dangerous to handle, and ultimately may lose its explosive properties. When pure it congeals, as a rule, at about 40° F., and is then very insensitive to blows or detonation. At 212° F. it begins to decompose; at 365° F. it throws off yellow or reddish fumes; at 423° F. it deflagrates violently. When uncongealed, nitroglycerin may readily be exploded by concussion, which renders it quite unfit for transportation in that state. In store it should be kept in a cool place, under pure water, in open vessels, and, if practicable, in a frozen condition. For use it should be thawed very gradually by placing the can in warm water raised to a temperature not exceeding blood heat. Any leakage should be carefully avoided at all times, and emptied cans should be destroyed. Flame applied to small quantities of nitroglycerin causes it to burn with difficulty like ordinary oil, but a fulminate exploded in contact with it produces a tremendous detonation. To develop its full effect, fulminating mercury, in quantities not less than 15 troy grains, and confined in a strong copper capsule, is recommended. Its advantages as an explosive consist in its instantaneous development of force, due to the fact that, pound for pound, it produces at least three and a half times as much gas, and twice as much heat, as gunpowder; its high specific gravity, which permits the use of small drill holes; its admitting of water, or loose clay, or even air, tamping; and, finally, the facility with which it can be made upon the spot for immediate use. Its disadvantages are the severe headaches it causes to those not habituated to its use, its liability to spontaneous explosion, the dangers sure to attend its careless handling, and, especially for military uses, its unfitness for being kept long on hand, unless prepared and treated with a degree of care not readily to be secured. To these may be added the fact that its rate of explosion is not under control, which restricts its economical use to blasting in hard rock or under water. In soft rock or clay its service at equal cost is inferior to that of common gunpowder, because its action is akin to a sudden blow rather than to a continued push.

Dynamite, now the generic name of a class of explosives, was invented in 1866–67 by Nobel. It first consisted of nitroglycerin absorbed by a porous, inert solid. The percentage of the former is, of course, limited by the capacity of the absorbent. The best material is a siliceous infusorial earth found in Hanover, Germany, and known as *kieselguhr*. It is when dried a white, impalpable powder, showing under the microscope a cellular structure. It will absorb and safely retain three times its weight of nitroglycerin. Many experiments were made in Paris during the siege of 1870–71 to discover the most suitable substitute there available. Finally, a residue from the gas-works was adopted, which would take up and retain a little more than its own weight of nitroglycerin. The use of a very absorbent kind of charcoal, made by carbonizing cork, has been patented, giving an explosive named carbo-dynamite, which it is claimed will retain nine times its weight of nitroglycerin and even resist wetting. With ordinary bases water causes a separation of the ingredients.

Dynamite made from kieselguhr has the appearance and consistence of heavy brown sugar. It possesses most of the virtues of the parent nitroglycerin, with some peculiar to itself; of which the chief are exemption from liability to spontaneous explosion and to detonation from moderate shocks, both of which result from the exceedingly fine granulation of the nitroglycerin. It was formerly largely used in the U. S., especially in California, and these important advantages are now generally admitted. Kieselguhr dynamite possesses another advantage over nitroglycerin. If kept in the state of loose powder without compression into cartridges, it may be exposed to any natural temperature without losing its explosive properties when subjected to the action of a primer charged with 15 grains of fulminating mercury; and this, too, without becoming more sensitive to ordinary shocks and handling. In the form of compressed cartridges it is as inexplosive when thoroughly frozen as nitroglycerin itself. Saturated with water it loses only a very small percentage of its explosive power, but requires a primer much more powerful than those ordinarily used. Ignited by a flame, and unconfined, it burns quietly without detonation. Experiment indicates that its explosive force is not quite so instantaneous as that of pure nitroglycerin; hence in certain kinds of resisting media, where a sustained pressure is required, the mechanical work performed by three-quarters of a pound of nitroglycerin in the form of dynamite may largely exceed that produced by a full pound of the unabsorbed material. This apparent paradox actually occurs in the submarine mines usually called torpedoes. For rock-blasting dynamite should be pressed firmly home and tamped with sand.

Dynamite possesses another merit. By modifying its ingredients in judicious percentages, a certain control can be exerted over the quickness of its action, and a classification similar to that of the different grades of gunpowder, but more restricted in range, may be made. The milder grades of such explosives, whatever be their specific names, are usually designated by the prefix No. 2, the stronger being known as No. 1. The tendency in the U. S. is to use the cheaper low grades in the larger drill-holes which they entail; in Europe, the higher grades and smaller holes are preferred.

Various have been the attempts to increase the strength of dynamite by replacing its inert base with different explosive materials. Measurements have established that neither the strength nor the economic value of a dynamite is proportional simply to the percentage of nitroglycerin it contains. An explosive base, properly selected, may add enormously to the energy developed. Moreover, for each base an economic loss occurs from increasing the percentage of nitroglycerin above a certain point. Of such compounds, glyoxaline, lithofracteur, and dualin were the earlier types.

Glyoxaline was invented by Abel shortly after the introduction of dynamite. It consisted of a mixture of guncotton pulp and potassium nitrate, saturated with nitroglycerin, and was made both in a granular and a cake form. It proved to be less troublesome in handling, owing to the granules being coated with an impermeable material which reduced the tendency to produce headache, but it was never largely introduced into practical use.

Lithofracteur was devised about the same time by Prof. Engels, of Cologne. Its precise composition was not made public, further than that it consists of 525 parts of nitroglycerin, 225 parts of silica, and 250 parts of mineral bodies; and analyses of different samples have exhibited varying results. One authority (Trauzl) reports 52 parts of nitroglycerin, 30 parts of kieselguhr, 12 parts of coal, 4 parts of sodium nitrate, and 2 parts of sulphur. Others place the proportion of sodium nitrate as high as 25 per cent.; others add guncotton. Lithofracteur is a pasty substance of dark color. Like the other compounds of nitroglycerin, it burns quietly when ignited by a flame, and explodes violently when fired by a detonating fuse. Water dissolves the sodium nitrate, and thus sets free a certain part of the nitroglycerin—of course a decided disadvantage. The compound exhibits explosive properties similar to dynamite, and offers equal security against concussion. Its use heretofore has been restricted chiefly to Germany and Belgium, although it has been experimentally tried in England, and was employed by the Germans in the war with France in 1870–71. In the U. S. the type is represented by Judson powder, which is very largely used. The lowest grade contains only 5 per cent. of nitroglycerin, and its function seems to be simply a detonator of the special variety of gunpowder which forms its base. Its intensity may exceed 40 per cent. of dynamite No. 1.

Dualin was invented by Dittmar shortly after dynamite, and its use has been chiefly restricted to Germany and the U. S. The patent describes it as consisting of "cellulose, nitrocellulose, nitrostarch, nitromannite, and nitroglycerin, mixed in different combinations, depending on the degree of strength which it is desired the powder should possess in adapting its use to various purposes." A sample supplied by the inventor for trial at the Hoosac Tunnel was found by analysis to consist of 60 per cent. of nitroglycerin and 40 per cent. of washed sawdust, not treated with nitric and sulphuric acids. Trauzl reports it as consisting of 50 parts of nitroglycerin, 30 parts of fine sawdust, and 20 parts of potassium nitrate. The best variety ever manufactured is believed to be cellulose derived from poplar pulp, treated with nitric and sulphuric acids, and saturated with nitroglycerin.

Having a less specific gravity than dynamite, dualin is slightly inferior to it, bulk for bulk, in explosive energy. When thoroughly soaked in water, it can be exploded only by a very violent detonation, much exceeding that of the ordinary fuse, and even then it loses more than half its power. It congeals at about 45° F., and in this state readily explodes, becoming so sensitive to friction as to make it dangerous to tamp in cold weather. In other respects its properties resemble those of dynamite.

Nitrogelatin.—In 1876 Nobel patented a new and important nitroglycerin compound, variously known as nitrogelatin, blasting gelatin or explosive gelatin. It consists essentially of nitroglycerin solidified to a stiff jelly by the addition of from 5 to 8 per cent. of carefully prepared nitrocellulose usually of the soluble form. A temperature of about 100° F., or the addition of a volatile solvent, is required in the manufacture. As nitroglycerin contains an excess, and nitrocotton a deficiency, of the oxygen needed for complete combustion, the resulting explosive should be more powerful than either ingredient, and experiment proves this to be the case to a marked degree. In appearance nitrogelatin is an elastic translucent jelly of a pale-yellow color, having a specific gravity of 1·6. Moderate confinement is necessary to develop its power of transmitting a wave of detonation. Unlike dynamite, its sensitiveness is increased by cold, so that when frozen special care in handling is demanded. It is wholly unaffected by water, and it may be handled without producing headache. In the manufacture extreme care is needed in purifying the ingredients to avoid a tendency to decomposition or liquefaction, but this result has been attained in practice, and the explosive is recognized as both stable and safe. The addition of from 3 to 5 per cent. of camphor forms *gelatine explosive de guerre*, and materially reduces sensitiveness to high temperatures, or to shocks even as severe as the impact of a musket ball, which in the uncamphorated form usually determines ignition, if not explosion. Strong detonators are required to develop full power. Even without camphor the range of sympathetic explosion under water is very much less than with dynamite. The Austrian explosive, ecrasite, which is claimed to have given remarkable results as a charge for shells, is believed to be a modified blasting gelatin. By the addition of nitrates, with or without carbon, gelatin dynamites of various grades are formed for use when reduced intensity of action will suffice.

When the proportion of nitrocellulose is increased to about 50 per cent., and of camphor to about 10 per cent., a horn-like substance is produced, known as Nobel's C. 189, or ballistite. Rolled into sheets and suitably subdivided, this is claimed to be one of the best "smokeless" powders now known, giving good results both in small arms and in cannon. It has been officially adopted by Italy, and is largely experimented with in Germany and elsewhere. Cordite, which also has a high reputation as a "smokeless" powder, belongs to this class; as does also leonard powder, which has recently done excellent work at Sandy Hook proving ground.

Forcite.—This is the American representative of the class of gelatinized nitrocompounds to which nitrogelatin belongs. It is manufactured on a large scale in New Jersey, and has been considerably used. Several grades are in the market. The strongest contains 95 parts by weight of nitroglycerin and 5 parts of a prepared cellulose of a special kind. It resembles blasting gelatin so much in appearance and properties that no further description is necessary here. By the addition of nitrates in varying proportions forcite dynamites are formed. They contain from 75 per cent. to 30 per cent. of nitroglycerin.

Terrorite or Perunite.—This nitrocompound, the invention of Prof. Mendeleff, is one of the latest of its class. It consists of 80 parts by volume of nitroglycerin, 10 parts of nitroethyl, and 10 parts of nitromethyl, and is a colorless volatile liquid, having a specific gravity of about 1·4. By dissolving in it from 8 per cent. to 24 per cent. of pyroxilin it becomes a semi-fluid paste of progressively increasing thickness, but never attaining the consistency of a solid jelly. Official trials have shown its strength to be phenomenal, exceeding that of nitrogelatin itself by upward of one-third as roughly measured. Its fluidity and volatile ingredients are serious objections.

The Chlorates.—The violent action of potassium chlorate upon readily oxidizable substances has given rise to many attempts to employ it in the preparation of substitutes for gunpowder. Under the names of white gunpowder and German gunpowder a mixture of this salt with potassium ferro- and ferri-cyanide and sugar has long been known. Mixed with nut-galls, resins, and other vegetable substances, it has been repeatedly introduced to temporary use as Horsley's powder, Ehrhardt's powder, etc. The form best known in the U. S. consists of potassium chlorate, potassium nitrate, and crude gamboge, which, under the name of Oriental powder, or safety compound of the Oriental Powder Company, was at one time considerably employed in the oil-wells of Pennsylvania and for other blasting purposes. Its dangerous sensibility to friction, and the consolidating effect of heat upon the gum, have prevented its general use. With some of these chlorate compounds sulphur enters as an ingredient, which intensifies the chief objection against them—their liability to explode from slight friction or percussion. As a class, they have many times the explosive intensity of gunpowder, but are also more dangerous to handle. For special purposes they are extremely useful—for instance, a mixture of potassium chlorate and sulphur, formed into a paste, and dried to fit small cartridge-cases of lead, has been found to be terribly effective as a charge for explosive bullets. They may be fired with safety from a musket, but explode with great violence, even in penetrating flesh.

It is in chlorate mixtures that the most important practical application of the researches of Dr. Herman Sprengel has been made. In 1873 he published a noteworthy paper indicating a new class of explosives, formed by mixing just before use an oxidizing and a combustible ingredient, each of which by itself is non-explosive. The proportions were adjusted to cause "their mutual oxidation and deoxidation to be thoroughly complete." Solids and liquids were both discussed. Hellhoffite (nitric acid and metadinitrobenzole) is one variety of the Sprengel class; Gruson introduced it for use in shells. Turpin brought these explosives forward in France, under the name of panclastites. In the U. S. Divine patented rackarock (potassium chlorate and nitrobenzole), which constituted the bulk of the charge at the destruction of Flood Rock, New York harbor, in 1885 (107 tons to 19 tons of dynamite). This explosive, being composed of a liquid and a solid, is not dangerously sensitive to friction when fresh, and before mixing is absolutely safe to handle, transport, or store in any quantities. At Flood Rock accident revealed another merit. Water leaked into some of the cans after they were in drill holes sloping downward. With dynamite this would have dropped free nitroglycerin on the floor of the headings, and men passing would probably have caused a premature explosion. The nitrobenzole was not only harmless, but by its well-known smell attracted attention and by its color pointed out the defective holes. It was found in the investigations preceding this great blast that (*a*) in rackarock the nitrobenzole should constitute 21 per cent. of the whole weight; (*b*) that dampness in the potassium chlorate largely reduced the intensity of action, 6 per cent., 4 per cent., and 2 per cent. of water causing losses of 19, 10, and 5 per cent. respectively; (*c*) that full detonation in moderate charges was secured by two fuses each containing 24 grains of mercuric fulminate, but that in the long drill-holes relay primings were desirable; and (*d*) that the explosive as supplied was very uniform, and possessed an intensity of action about 8 per cent. greater than dynamite No. 1.

The Picrates.—Picric acid was discovered in 1788 by Haussman while treating indigo with concentrated nitric acid. Chemists have derived it from other substances, especially from carbolic acid. It has been called *amer d'indigo*, *amer de Welter*, carbonitric acid, nitropicric acid, carbazotic acid, and trinitrocarbolic acid. It is a crystalline body of a brilliant golden yellow, very bitter to the taste, and is largely used as a dye. When heated to 600° F. it detonates with violence.

The salts obtained by treating many of the bases with picric acid possess its characteristic properties; that best known is the potassium picrate. This forms golden crystals having a metallic reflection. Insoluble in alcohol, and but slightly soluble in water, it detonates violently at 600° F. Its action is akin to that of the fulminates in suddenness; and to regulate this property, Designolle has mixed it with charcoal and potassium nitrate, thus forming a compound similar to, but more powerful than, ordinary gunpowder. To obtain the maximum explosive energy, he employs equal parts of potassium nitrate and potassium picrate. For use in rifles from 12 to 20 per cent. of potassium picrate is used, with a small amount of charcoal. For cannon only from 8 to 12 per cent. of potassium picrate is employed. Under the name of *poudre Designolle* this compound has been considerably manufactured in France for military purposes, both for large guns and for torpedoes.

Brugière powder consists of an admixture of ammonium picrate and saltpeter. It is comparatively a slow powder, less liable to attract moisture than ordinary gunpowder, and yielding but little smoke. In England, Abel has experimented with a similar compound, to which he has given the name of picric powder, and which he considers especially suited for use in shells, because, although little liable to explode from concussion or friction—the great objection to the potassium picrate compounds—its effects when strongly confined are more violent than those of gunpowder.

To the class of picrates belongs mélinite, although neither its original composition (said to be fused picric acid and nitrocellulose dissolved in ether) nor its successive modifications are certainly known. It has been adopted in France as a charge for shells, and according to report has been thus fired with safety in charges exceeding 100 lb. in weight. According to the latest reports, cresilite is combined with mélinite for this purpose, in the proportion of about 3 to 1 by bulk. Lyddite, which has received considerable attention in Great Britain, is similar in composition to the original mélinite.

In the U. S. the class is represented by emmensite—the invention of Dr. S. H. Emmens. Experiments by the Government have shown it to possess decided merits, especially for use in shells. The highest grade consists of eacid and nitrate of ammonia. For the trade three grades are manufactured. The first, for ordinary blasting, consists of picric acid, sodium nitrate, and ammonium nitrate. The second for military uses in shells, etc., is composed of picric acid and dinitrobenzene, with sodium nitrate and ammonium nitrate. The third, for projectile uses, consists of picric acid, sodium nitrate, and charcoal or flour. The grade for shells has been tested by the Government with promising results. It is of a pale yellow color, and the odor of nitrobenzole is strong. It is singularly insensitive to shocks, and in intensity of action it takes rank with guncotton; but taking into account its superior density when solidly compacted it is stronger than that explosive in the ratio of about 5·5 to 3·2.

The picrate class has not been neglected in efforts to obtain a "smokeless" powder. France has led the way in this direction, but so much secrecy has been observed that few details are known. Poudre B or Vieille powder, formerly used in the Lebel rifle, is believed to contain picric acid as an important ingredient. The latest modification is known as BN powder.

The Fulminates.—The violent action and dangerous sensitiveness of explosives of this class restrict their use to a limited field. By far the most important among them is mercuric fulminate, which is the best agent known for inducing detonation in all high explosives, and which in consequence is now largely used for that purpose, either alone or mixed with potassium chlorate. Commercially, it is supplied in long copper capsules of eight grades, according to strength. They are called "detonators," and contain from 0·3 to 2 grammes of explosive. Trebles (0·54 gramme) are usually employed with low grades of dynamite, but for less sensitive explosives heavier charges are more economical even when not absolutely necessary.

Fulminate of silver is used in minute quantities in toy fireworks. Fulminate of copper is excessively sensitive to frictional electricity, being readily fired by sparks far beyond the cognizance of the sense of touch. It was formerly much used as a fuse-priming in blasting, but many accidents resulting from oversensitiveness have now banished such fuses from the market. HENRY L. ABBOT.

Exponent [from pres. partic. of Lat. *expo'nere*, set forth, expound]: in algebra, a number or symbol representing a number which, when written above and at the right hand of any symbol of quantity, indicates a corresponding power of that quantity. Thus a^3 denotes the *third power of a*, and 3 is said to be the *exponent* or index of that power; usually, though less correctly, it is called the exponent of a. Thus a^3 is merely an abbreviation of aaa, and from the definition of an exponent it follows at once that $a^{m+n} = a^m a^n$. The notation of exponents was introduced by Descartes, and being very convenient was soon extended. The convention on which the extension is based is the general truth of the above equation. Thus if the meaning of a negative or fractional exponent is asked for, on the hypothesis that the above equation shall hold for all values of m and n, it is found that since $a^m = a^{m+0} = a^m a^0$, a^0 must be a symbol for 1, no matter what a represents.

Exponential Equation: an equation involving terms wherein the unknown quantity is an exponent or constituent of an exponent. The simplest form of such an equation is $a^x = b$; one of its solutions is the logarithm of b to the base a, or, what is the same thing, the ratio of the logarithm of b to that of a, the bases being the same, but arbitrary. This is one solution only; the equation has many other imaginary roots, and is consequently transcendental. A curve in whose equation the co-ordinates appear as exponents is also called an exponential curve. The logarithmic curve is an example.

Exposition, Cotton States: See the Appendix.

Expositions, International and **Universal**: a name applied to the great public exhibitions which have been held, since the middle of the nineteenth century, in various countries, of the products of the industry and of the evidences of culture, intellectual and æsthetic, of all nations; notably, to those of London in 1851 and 1862; to those of Paris in 1855, 1867, 1889, and 1900; to that of Vienna, which was held in 1873; to that of Philadelphia, which was held in 1876; and to that of Chicago in 1893. These grand displays may be regarded as the development on the largest scale of an idea which, for the preceding fifty or sixty years, had had many less imposing manifestations—the idea that, in order to the improvement of the arts of industry, the first requisite and the most effectual incitement is to be found in acquainting a people with the actual state of those arts as they exist. These expositions, therefore, though nominally universal, comprehended in their first conception and in their earliest practical illustrations only what are called the useful arts, in contradistinction to the liberal and the fine arts; and they furthermore omitted from their scheme the evidences of that kind of moral activity which aims to ameliorate the condition of the human race by repressing vice and crime, by relieving distress, by diminishing the amount of disease, by the improvement of prison discipline, by softening the horrors of war, and by other means analogous to these; all of which have been kept more or less in view in the later. The early international expositions, moreover, omitted to provide, or at least provided only on a limited scale, for the display of animals useful to man, or of living and growing vegetables, plants, and flowers, or for illustrating the operations of the garden, the field, the farm, and the dairy. The later have given to these objects a very large portion of their space.

Public exhibitions of the products of industry were in the first instance held as marts or fairs. (See FAIR.) The earliest held not for commercial purposes, but strictly for the promotion of improvements in the useful arts, were instituted by the Society of Arts of London. This society has held such exhibitions annually since 1760. The first properly national exhibition of this kind, the first, that is to say, organized under government direction, took place in France in 1798. Since that time the French Government has given a similar exhibition every four or five years. The effect has been greatly to improve the quality and to enlarge the quantity of production in all the departments of industry throughout France.

In the U. S. exhibitions for the encouragement of agricultural or mechanical industry have long been annually held under State and county organizations, with partial aid from the State governments, in some States of the Union, and more recently in many. The Franklin Institute, founded in 1824, in Philadelphia, the American Institute established four years later in New York, and many less conspicuous though perhaps not less useful associations organized for promoting industrial improvement, have relied on public exhibitions as among the most effectual means of accomplishing their objects.

Of international expositions, the first in the series, that of 1851 in London, was undertaken at the suggestion, and successfully carried out through the influence, of Prince Albert, who was at that time the president of the London Society of Arts. A building was erected in Hyde Park for the accommodation of the objects entered for exhibition, upon a design of an entirely novel and original character proposed by Joseph (afterward Sir Joseph) Paxton, a landscape gardener, at that time in charge of the gardens of the Duke of Devonshire at Chatsworth. The materials employed were almost exclusively iron and glass, whence the structure received the name of "the Crystal Palace," a name which has been applied to other similar constructions since. The plan was a long rectangle with a transept crossing the center, the whole covering an area of more than 20 acres of ground. In the contract for the erection of the building it was stipulated that at the close of the exhibition it should remain the property of the contractors, which stipulation reduced the cost to the commissioners by £100,000, or half a million of dollars. The total cost for building, maintenance, superintendence, recompenses to exhibitors, legal expenses, etc., was about £293,000. The total receipts from all sources were £506,000, showing that the exhibition, apart from the large and permanent indirect benefits accruing from it, was a direct financial success. This can not be said of any of those which have succeeded it.

The universal admiration attracted by the exposition of 1851 and its brilliant results stimulated a similar undertaking, two years later, in New York. The short intervening time allowed for preparation, and the distance of the place of exhibition from the countries most advanced in manufactures and other productive arts, suggested a large reduction in the scale of the display. The location selected was a public square, only 445 feet by 455 feet in dimensions, or about 4⅔ acres. Upon this a "crystal palace" was erected octagonal in ground plan, but having above two naves intersecting symmetrically at right angles, each 365 ft. 5 in. by 149 ft. 5 in. The intersection was crowned by a hemispherical dome, 100 feet in diameter, the height of the springing line being 70 feet, and the total height to the summit above the crown 123 feet. In order to increase the extent of floor surface for the purposes of the exhibition, spacious galleries were constructed in the arms of the building, the total surface thus secured amounting to 250,000 sq. feet, or 5¾ acres. The cost of the building was about $200,000, to defray which and to maintain the exhibition money was raised by an issue of stock, at first to $300,000, afterward increased to $500,000, in shares of $100 each. These shares soon rose in value, and they were at one time at a premium of 75 per cent. The enterprise nevertheless resulted in loss, the destruction of the building by fire a few years later having finally destroyed all prospect of redeeming its fortunes.

During the same year, 1853, a similar international exhibition was held in Dublin, in a building forming a series of parallel halls. The cost was £80,000; the receipts, £47,000.

The Paris International Exposition of 1855 was in effect a private enterprise, but it was conducted by a commission appointed by the Government, which also undertook to secure it against loss. The principal building on this occasion was erected of masonry in the Champs Elysées. The great hall devoted to the exposition was lighted from the roof. This building provided an extent of 1,770,000 sq. feet of floor surface to the industrial departments not employing machinery in motion. The machinery was established in an "annex" on the bank of the Seine, 4,000 feet long. The fine arts were provided for in another building; and the tapestries and carpets of the imperial establishments, as well as the crown jewels, in still another. This exposition cost 11,264,520 francs = $2,253,000, not including the cost of the main building, which was preserved as the property of the Government, under the name of the "Palais de l'Industrie," to be used for annual exhibitions of various kinds and for public ceremonials.

The second London Universal Exposition was held in 1862. For this, the location chosen was upon grounds which had been purchased at South Kensington by the commissioners of the exposition of 1851, with the surplus proceeds of that exposition and some aid from the Government. The principal building was nearly rectangular, and covered about 7 acres. The whole area covered by roofs was about 23 acres. The buildings were subsequently removed, the space occupied by them being required for Government purposes, and the principal one was transferred to the north of London, where, under the name of the Alexandra Palace, it was totally destroyed by fire in June, 1873.

The international exposition of 1867 at Paris was the most comprehensive in its plan, the most elaborate in its preparations, and the most colossal in its dimensions, of all which had been held up to that time. The Government announced its intention four years in advance. In June, 1865, an imperial decree created a commission to direct the work, under the presidency of Prince Napoleon, who shortly after resigned, and was replaced, in Feb., 1866, by the Prince Imperial. The place fixed upon for the principal exhibition was the Champ de Mars, the large paradeground in front of the École Militaire, containing about 111 acres. For the exhibition of farm and dairy operations, animals, and stock, the island of Billancourt in the Seine, 2½ miles from the Champ de Mars, was chosen, having an area of 74 acres. For the competitive trials of mowers and reapers and for other field operations, portions of the emperor's farms at Fouilleuse, near St.-Cloud, and of those at Vincennes, were given up as occasion required. The margin of the Seine in front of the Champ de Mars (from which it is separated by the Quai d'Orsay), offering an area of about 3 acres, was devoted to objects connected with navigation, to diving apparatus, and to machinery for raising water. Here also was found a convenient place for a chemical laboratory in which experimental lectures were delivered during the exposition. The principal exposition building was constructed mainly of iron, and was of enormous dimensions. The entire space inclosed within its exterior walls was 36 acres, but there was an open central court of about an acre in the center. This building occupied the center of the Champ de Mars. The surrounding area was called the park, and was allotted to the different countries represented in the exposition, for the construction of buildings to accommodate objects or to facilitate operations which could not be allowed in the main building, or to illustrate the characteristic domestic or school architecture of different peoples; or for more imposing structures representing the temples and palaces of prehistoric antiquity.

The principal building, or so-called palace, was constructed without any attempt at architectural effect, but with the design to make as conspicuous as possible the method of arrangement with reference to the plan of classification by correlated groups of objects, and by countries; and so to enable the visitor to study the exhibition easily and to enable him readily to find any particular object sought. It had the form of an ellipse with flattened sides, or more properly of a parallelogram with circular ends, the extreme length being 490 meters, or 1,607 feet, and the extreme breadth 380 meters, or 1,246 feet. The entire cost of the structure, including the necessary excavations and other earthworks, was about 11,785,000 francs = $2,357,000.

The total expense of the exposition on all accounts, from the beginning to the final liquidation, amounted to 22,983,-817·99 francs = $4,596,764. The total return produced by the exposition was only 14,114,662·09 francs = $2,822,900; but there was a "subvention" of 6,000,000 francs by the Government, and another of like amount from the city of Paris, making the total receipts 26,114,662·09 francs; giving an excess of 3,130,844·10 francs = $626,000 above expenditure. From calculations made by the imperial commissioners in their final report, it appears that the actual number of admissions to the exposition during its continuance, including repeated admissions of the same person, was 15,000,000, or upward, and that the average number of admissions daily was nearly 70,000. The number of exhibitors was 51,819.

The International Universal Exposition at Vienna, Austria, opened May 1 and closed Nov. 3, 1873. The Archduke Charles was protector. The location selected was the famous Prater, the park and favorite place of resort of the Viennese, lying about 1½ miles from the center of the city, and between it and the Danube. About 280 acres were inclosed by a high board fence. The principal buildings, all of one story and without galleries, were the Industry Palace, Machinery Hall, Art Buildings, and Agricultural Halls, ranged side by side in three zones. The rotunda of the Industry Palace, designed by Scott Russell, and made of wrought iron, was the chief architectural feature of the exhibition. It was a flat, truncated cone, with a pitch or slope of about 31°; a diameter to the edge of the base of 354 ft. 8 in.; the interior height to the base of the large lantern being 158 feet, and to the top of the crown 276 feet. The cost was $500,000. The display in all departments was very large and costly, exceeding that at Paris in 1867. The number of exhibitors was stated at 70,000. The exhibition was particularly rich in educational appliances and statistics of all countries, special attention to the subject having been requested in the official programmes. A succession of international congresses during the progress of the exhibition was a marked feature, and contributed to its interest and good results. The Medical Congress, the Congress on a Uniform numbering of Yarn, the Flax Congress, and the International Patent Congress were among the most important.

The entire number of visitors recorded at the turnstiles was 7,254,687. The gross revenues were about $2,000,000, and the expenditures about $9,850,000. The deficiency of some $7,850,000 was provided for by Government appropriations.

The Paris Universal Exposition of 1889 was much more extensive than any that had hitherto been held. It was designed primarily to commemorate the French Revolution, and therefore the only governments to give to it their official recognition were those of the U. S. and Switzerland. In response to the invitations of the French Government, however, executive commissions were formed in Great Britain and in most of the continental states to encourage private participation in the exposition. The results of these efforts were most gratifying. The exhibition occupied a much larger space than any of its predecessors. It completely covered the space of the Champ de Mars, and it was connected by the Pont de Jena with the gardens of the Trocadero. The exhibition buildings were constructed chiefly of iron and glass, and many of them had very picturesque designs. About 5,000,000 French people and 1,500,000 foreigners visited the exposition during the summer. There were 60,000 exhibitors, and of these 903 received grand prizes, 5,153 gold medals, 9,690 silver medals, 9,323 bronze medals, making a total of 33,139 awards. An even more successful exposition was held in 1900. There were 79,712 exhibitors, 6,674 from the U. S., 2,827 grand prizes were awarded, 8,166 gold medals, 12,244 silver medals, 11,615 bronze medals, and 7,938 honorable mentions. More than 50,000,000 persons attended the exhibition.

See PHILADELPHIA (U. S. Centennial Exposition); COLUMBIAN EXPOSITION, WORLD'S. Revised by C. K. ADAMS.

Exposition, Pan-American: See the Appendix.

Expositions, Permanent: See the Appendix.

Ex post facto [Late Lat. *ex postfacto*, from or in reference to what is done afterward; *ex*, from, and *postfacto*, abl. of partic. *postfactus*, done afterward]: a legal term transferred from the civil to the common law. An *ex post facto* law is a law that operates by after-enactments. By the Constitution of the U. S. neither Congress nor the State Legislatures can pass *ex post facto* laws, and the meaning of the term thus used has been often defined and is fully settled by judicial decisions. It refers to criminal and penal statutes only, and not to those which simply affect private property. Chief Justice Marshall defined an *ex post facto* law to be one which rendered an act punishable in a manner in which it was not punishable when it was committed. The more specific definition usually laid down by the courts is: 1, any law which makes an innocent act, done before its passage, criminal; 2, any law which aggravates a crime, and makes it legally greater than when it was committed; 3, any law which changes the punishment, and inflicts a greater punishment than the law affixed to the crime when it was committed, or perhaps one different in kind; 4, any law that alters the legal rules of evidence applicable to an offense already committed, and to the injury of the offender.

Express [from Lat. *expri'mere*, to express, make definite and plain, past partic. *expres'sus*, clear, precise, definite, from which developed in the Rom. languages the meanings, special, special message, messenger]: (1) Fast passenger service. The minimum standard of express trains in Great Britain is about 40 miles an hour; in the U. S., 30 miles (except on the transcontinental and extreme Western lines); on the continent of Europe, about 25 miles. In the year 1888 Great Britain had 63,000 miles of trains daily running more than 40 miles an hour, the U. S. 14,000 miles, continental Europe almost none. Since that time these figures have been improved, especially in the U. S. and in Germany. The fastest trains in the U. S. are quite as good as the fastest British trains, but there are not nearly so many of them. An express on the New York Central road, running from New York to Buffalo, makes 440 miles in eight hours and forty minutes. The best systems of expresses are on the Baltimore and Ohio and Pennsylvania railways between New York and Washington. The best British expresses are between London and Edinburgh or Glasgow, their highest performances being nearly equal to those on the New York Central. On the continent of Europe the best trains are between Hamburg and Berlin.

(2) Arrangements for fast conveyance of parcels. In continental Europe this service is performed by the post-office; in the United Kingdom mainly by the railways themselves, though the parcels-post is also well developed; in North America by companies specially organized for the purpose. The parcels express business was started by W. F. Harnden between Boston and New York in 1839, this forming the beginning out of which the Adams Express Company ultimately grew. The Wells-Fargo Express was started in 1845, and the American Express some five years later. Besides these the most important companies are the United States and the Southern. Efforts have been made to induce the railway companies to do the work of collection and delivery, as is done in Great Britain, and thus supersede the necessity for express companies; but such experiments in Massachusetts and elsewhere have proved on the whole unsuccessful. See also FAST FREIGHT LINE. A. T. HADLEY.

Exterritoriality: that legal fiction which permits to certain persons or classes of persons who may be in a foreign land exemption from its jurisdiction. The laws of their own country therefore still govern them as if they had never left it. The classes of persons to whom these privileges may be granted are five:

(1) *Sovereigns.*—By the courtesy of nations these, with their suites, are not held subject to local jurisdiction, but their entrance may be refused or this privilege withdrawn. And they are still subject to the limitations imposed upon them by their own laws. If they own real property in a foreign country, that is not exempt from taxation.

(2) *Public Armed Vessels.*—A merchant ship on the high seas is governed by the laws of its own country; in a foreign port by the laws of that state. But a man-of-war in a foreign port applies the jurisdiction of its own country to its own crew on board. On shore, however, they are amenable to the local law. A ship of war can not exercise any war right, as of capture, within the waters of a friendly state. Its privileges are to be strictly construed, and are allowed for the sake of its representative character and for the proper control of its crew.

(3) *Armies in Transit.*—When such transit is permitted,

the army will be governed by its own officers, and its own military law will be in force. Otherwise it could have no cohesion, and control over it would be gone. But it is to be remarked that such transit is most unusual, and if granted in time of war, or in preparation for war, would inevitably amount to a breach of neutrality.

(4) *Diplomatic Agents and Consuls in Certain Countries.*—For an explanation of their exterritorial privileges, see DIPLOMATIC AGENTS and CONSUL.

(5) *Foreigners Resident in Certain Oriental States.*—Where the laws, the usages, the judicial system, and the state of civilization in a country are so different from the European standard, and so barbarous as to fail in guaranteeing the protection to person and property of resident foreigners, the latter may be allowed, in accordance with treaty, to remain under the jurisdiction of their own laws, though frequently subject to conditions as to behavior or residence. The U. S. have treaties securing to their citizens such privileges with Borneo, China, Korea, Japan, Madagascar, Persia, Turkey, Samoa, Siam, Tonga, and Zanzibar, and to a less degree with certain of the Barbary states.

T. S. WOOLSEY.

Extract [from Lat. *extrac'tus*, drawn out, past partic. of *extra'here*; *ex*, out + *tra'here*, draw]: in pharmacy, any solid substance (called simply an extract) or liquid substance (fluid extract) made by evaporating solutions containing medicinal principles, chiefly of vegetable origin. These solutions are made (1) by expressing the juices of fresh plants, or of dried ones after maceration, by means of hydraulic or other presses; (2) by means of liquid solvents, as water, alcohol, or ether, from which result "aqueous," "alcoholic," and "ethereal" extracts. These various methods are employed, some extracts being better prepared by one and some by another process. Sometimes the menstruum is allowed slowly to percolate and repercolate through the powdered drug, the solvent being at last removed by evaporation or distillation. Evaporation is frequently carried on *in vacuo* with great advantage, for a high degree of heat is injurious to many vegetable principles.

Extract of Meat (Lat. *extractum carnis*): a preparation of beef, and sometimes of mutton, or of both combined, in which the muscular fiber, fat, and gelatin are removed, and the highly nitrogenous elements preserved and condensed into a semi-solid mass of about the consistence of ordinary butter. Commercial extract of beef is prepared on a large scale in the Argentine Republic, in Texas, and in other countries. Most of what is sold in Europe and the U. S. comes from Buenos Ayres, where its manufacture was first established under the supervision of the chemist Liebig. One establishment at Fray Bentos slaughters 400 oxen daily. In general the finely cut beef is allowed to stand for a few hours in cold water; the liquid is then boiled for a time, and afterward evaporated in a vacuum-pan. In some places the mincemeat is steamed, and the resulting liquids evaporated on rapidly revolving steel plates. In other establishments superheated steam is employed under pressure; the material is then submitted to powerful hydraulic compression, and the expressed liquid partially dried *in vacuo*.

Extract of meat is of variable quality and composition, and at the best but imperfectly represents the beef it was made from; some forms of it are stimulants merely. Nevertheless, it is useful in preparing soups, and especially in nourishing those who are sick of low fevers, pyæmia, and other like diseases.

Extradition [from Lat. *ex*, out + *tradi'tio*, act of delivering over, surrender; *trans*, across + *dare*, give]: the surrender by one state or nation to another of fugitives from justice. The subject will be considered under two general divisions: 1, the surrender of fugitives from justice from one State of the U. S. to another; 2, the like surrender as between one nation and another.

1. The U. S. Constitution provides that "a person charged in any State with treason, felony, or other crime who shall flee from justice and be found in another State, shall, on demand of the executive authority of the State from which he fled, be delivered up to be removed to the State having jurisdiction of the crime." A like clause is found in the Articles of Confederation. The propriety and necessity of such a provision in the case of States bound so closely together as are those of the U. S., and yet exercising independent criminal jurisdiction, will not be questioned. It tends to promote harmony between the States and to repress crime, while it aids in the discharge of a high moral obligation. An act of Congress of Feb. 12, 1793, ch. 7, § 1, carries the constitutional provision into practical effect by declaring that the demand shall be accompanied by a copy of an indictment found against the alleged fugitive, or by an affidavit made before a magistrate of a State, etc., charging the fugitive with having committed a crime. These documents are to be certified as authentic by the Governor or chief magistrate of the State whence the demand comes. It is thereupon made the duty of the Governor on whom the demand is made to issue his warrant and to cause the fugitive to be arrested and delivered over to the agent of the demanding State. The essential ingredients of the case are that there must be a charge that an act has been committed which is a crime under the laws of the State where it took place, and that the person so charged has fled from justice. The Governor of the State where the fugitive is found is bound to comply with the demand when properly made and authenticated. Still, should he fail to do his duty, there are no legal means whereby he can be compelled to perform it. (*Kentucky* vs. *Governor Dennison of Ohio*, 24 Howard's Reports, 66.) If the fugitive is supposed to be arrested on insufficient papers, the regular course to test their validity in his behalf is to apply for a writ of *habeas corpus*. If they turn out to be defective, he will be discharged. When the proceedings are sustained, their effect is to return the fugitive to the State whence he came, where he will be entitled to his trial under the ordinary course of judicial proceedings.

2. Extradition as between separate nations is a topic belonging to international law. It is a limitation of the right of asylum. It was at one time supposed that it was the duty of a state under the law of nations to surrender up a fugitive from justice upon demand after the civil magistrate had ascertained the existence of reasonable grounds for subjecting the accused to a criminal trial. Those who maintained this doctrine found much difficulty in drawing the line between the graver crimes to which it was claimed that this rule was applicable and those of a minor character to which it could scarcely be considered that it would extend. (1 Kent's *Commentaries*, 37.) The better opinion now is that whatever obligation may exist in such a case is an imperfect one, and can not be insisted upon by the demanding nation unless there be a treaty stipulation. Nevertheless, in certain cases, extradition without treaty has been allowed by and to the U. S. In 1863 Secretary of State Seward surrendered Arguelles to Spain "under the law of nations and the Constitution of the U. S." on account of his high criminality. And the notorious Tweed was given up by Spain in 1876, an exact return for the former courtesy. Many similar demands upon the U. S. have been refused, and both law and usage are against the practice. The U. S. have treaties upon the subject of extradition with a large number of foreign nations. The following is believed to be a complete list of such treaties in force in 1893:

Great Britain	1842, 1890	Würtemberg	1868
France	1843, 1845, 1858, 1893	San Salvador	1870
Hawaiian islands	1849	Nicaragua	1870
Swiss Confederation	1850	Orange Free State	1871
Prussian and other states of the Germanic Confed.	1852	Ecuador	1872
Bavaria	1853	Ottoman Empire	1874
Austria	1856	Spain	1877, 1882
Baden	1857	Belgium	1882
Sweden and Norway	1860, 1893	Luxemburg	1883
Mexico	1861	Japan	1886
Haiti	1864	The Netherlands	1887
Dominican Republic	1867	Colombia	1888
Italy	1868, 1869, 1884	Russia	1893

The treaties are not precisely identical, though of the same general scope and character. They all include the more heinous crimes, such as murder and piracy, while some of them embrace robbery, burglary, arson, rape, embezzlement, and the fabrication and circulation of counterfeit coin or paper. The words here employed would refer to the offenses named as understood in the general jurisprudence of the two nations, and accordingly would not extend to a new statutory crime established by one of the United States, and called by a name used in the treaty, such as forgery. This conclusion was reached in Great Britain in the case of Winsor, 6 Best & Smith's Reports, 522. On the other hand, it has been considered that the word "piracy," as used in the treaty with Great Britain, does not refer to that offense as recognized in the law of nations, as the offender can be tried in the state where he is. Its reference is to piracy under the municipal law of the state making the demand. (*In re Tivnan*, 5 Best & Smith, 645.) The treaties require that the offense should be committed within the "jurisdiction" or within the "territories and jurisdiction" of the demanding nation. An interesting question has arisen in the U. S. as to whether these words would include the case where a nation by statute law made it a crime for one of its own subjects to commit an act like murder beyond its own territory, so that a surrender could be demanded by that nation, though the act were committed within the territory of a nation with which the U. S. had no extradition treaty. This was the case of Vogt, and, though the Attorney-General of the U. S. advised against the surrender, the point can scarcely be deemed to be finally settled. In order to carry an extradition treaty into practical effect, domestic legislation is necessary. Under the laws of Congress and the practice of the courts the following points must be observed: (1) There must be a demand from the supreme political authority of the state seeking the return of the fugitive; (2) There should be an authorization or a mandate by the President of the U. S., directed to a judge or U. S. commissioner, to examine into the case; (3) Complaint under oath should be made to the judge or commissioner by a proper person, such as a consul-general of the foreign country, showing the commission of the act on which the demand for the surrender is based; (4) There should be a warrant by the commissioner, etc., for the apprehension of the party charged; (5) The charge should be sustained before the commissioner by suitable evidence, such, for example, as would justify his commitment had the act taken place here; (6) On the certificate of the judge or commissioner that there is a probable ground to believe that the offense has been committed, and such certificate being satisfactory to the President of the U. S., the surrender is made to the agent of the demanding state. If the proceedings are defective, the prisoner may be discharged on a writ of *habeas corpus*. An extradition act was passed in Great Britain in 1870 to which all extradition treaties were to conform. The leading provision of this was that there should be no surrender without proper assurance that the accused shall be tried for no other than the crime specified in the demand. The attempt to apply this condition to the extradition of 1842 with the U. S. in Winslow's case, 1876, in other words to a prior contract, led to a temporary suspension of the agreement. The 1890 treaty accepts the conditions of the extradition act, and extends the list of extraditable crimes somewhat in the direction of fraud and embezzlement. The statutes relating to extradition in the U. S. will be found in 9 U. S. Stat. at Large, 302 (Aug. 12, 1848); 12 *ib.*, 84 (June 22, 1860); 15 *ib.*, 337 (Mar. 3, 1869). Consult also *Matter of Farez*, 7 Blatchford Reports, 345, 491; Brightly and Abbott, *Digests*, title *Extradition*; Wheaton, *International Law*, notes of Lawrence and Dana; Clarke, *On Extradition*, etc.: English statutes, 33 and 34 Vict., ch. 52 (1870); 36 and 37 Vict., ch. 60 (1873). See also the article ASYLUM (International Law). Revised by T. S. WOOLSEY.

Extraterritoriality: See EXTERRITORIALITY.

Extreme Unction [from Lat. *extre'ma unc'tio*, last anointing; *unctio*, deriv. of *un'guere*, *unctum*, anoint]: the fifth of the seven sacraments of the Roman Catholic Church, consisting of liturgical prayers recited by the priest and of the application, by the priest, of consecrated oil of olives (*oleum infirmorum*) to the eyes, ears, nostrils, lips, hands, and feet of a dying person or of one whose illness is alarming. It is administered, when possible, after confession and the Eucharist, and is believed to remove the last stains of sin, strengthen the patient spiritually, and, if required for his salvation, restore him to bodily health. The Greek and Coptic Churches recognize unction (which is by no means always administered *in extremis*) as a sacrament, and the Jacobites and Armenians have a similar practice. Certain ritualists among the Anglicans and Lutherans advocate a return to this ceremony. St. James v. 14, 15, thus describes the nature and effects of this sacrament: "Is any man sick among you let him call in the priests of the church, and let them pray over him, anointing him with oil in the name of the Lord. And the prayer of faith will save the sick man, and the Lord will raise him up and if he be in sins they shall be forgiven him." Roman Catholics hold extreme unction to be of divine institution, as no one but Christ could make it the means of forgiving sin. Revised by J. J. KEANE.

Exudation [from Lat. *ex*, out + *suda're*, to sweat]: the passage of a liquid outward through the walls (or membranes) of the vessel containing it. The term is also applied to certain substances which *exude* or come out of trees, as gum-resin, manna, etc. In pathology, exudation is a material product of inflammation; a gaseous, liquid, or solid substance foreign to the tissues, and resulting from disease. These morbid products, when solid, sometimes become organized and capable of growth.

Exu'ma, Great and **Little**: two of the Bahama islands. The former is about 30 miles long and 3 miles wide, and has one of the best harbors in the Bahamas. Salt is exported from them. Great Exuma is crossed by the Tropic of Cancer. The northwest point is in lat. 23° 42′ N., lon. 76° W.

Exuviæ, eks-yu'vi-ē [Lat., spoils, what is stripped off; deriv. of *exu'ere*, to strip off; cf. *induviæ*, clothes, to *indu'ere*, put on]: in natural history, the slough or cast-off skins of reptiles, crustaceans, insects (see ENTOMOLOGY), etc.; the molted feathers of birds; the hair of quadrupeds, which is shed at a particular season of the year. The term was anciently used to designate the personal spoils taken from an enemy in battle, hence it sometimes meant all booty taken in war.

Eyck, īk, JOHN, or JAN, van: painter; b. at Bruges in 1370. He worked together with his brother HUBERT, who was the elder in years but not in artistic merit; b. 1366 at Maestricht, d. in 1426. John van Eyck revived the art of painting in oil in attempting to obviate the tendency of paints to crack when exposed to the sun. This secret, jealously guarded by the brothers, was discovered and revealed to others by Antonello of Messina, who was painting at Bruges. The most important work of the two brothers is the *Adoration of the Spotless Lamb*, a picture with many subordinate or accessory pictures forming a great triptych. The chief picture, which is a large composition of many figures, is in the Church of St. Bavon at Ghent. The wings contained eleven separate pictures; all but two of these, which are in Brussels, are in the Museum of Berlin. John died at Bruges, according to one authority, July 9, 1440.

Eye [O. Eng. *ēage*: O. H. G. *ouga* > Mod. Germ. *Auge*: O. Sax. *ōga*: Icel. *auga*: Goth. *augō*, connected with Lat. *o'culus*, Gr. ὄσσε (**okie*), Sanskr. *akshi*]: the organ of vision. Eyes may be variously developed, and are by no means homogeneous throughout the animal series, but in the vertebrates, when developed, they are two in number, and essentially correspond in all. Among the more notable deviations are the apparently double eyes of ANABLEPS (*q. v.*), and the development of the two on one side of the head in flat fishes. Supposititious eyelike organs are in addition developed on the trunk in certain fishes.

The human eye is placed in a bony cavity called the orbit, and is further protected by the fatty cushion, within which it rests, as well as by the brows, eyelids, and eyelashes. Other appendages are the tear-gland and the sac and duct connected with it, the numerous muscles which direct its range, and the nerves and blood-vessels which supply it.

The human eye is a globe, with the segment of a smaller globe planted upon its anterior aspect. Its antero-posterior diameter is about an inch, its transverse one about eleven-twelfths of an inch. The larger sphere has about five-sixths of the whole surface. The eye is invested by three coats—first, the sclerotica, a white, tough, fibrous substance, the "white of the eye," visible through the delicate conjunctiva which covers its anterior portion and is reflected over the inside of the lids. The muscles are attached to it, and through a sieve-like "cribriform lamina" it transmits the filaments of the optic nerve with the vessels supplying the retina. The anterior sixth of the eye's surface is occupied by the transparent cornea. This is composed of four layers: (1) an outer epithelial layer continuous with the conjunctiva; (2) a central layer, the cornea proper; (3) an elastic layer; and (4) a posterior layer of cells which lines the anterior chamber. The cornea is a non-vascular body, and is nourished by imbibition from the surrounding capillaries, which terminate in loops at its border. It is freely supplied with sensitive nerves, and the cornea proper contains spaces (corneal spaces), each one occupied by a small body, called a corneal corpuscle.

The second coat of the eye is composed of the choroid tunic, the iris, and the ciliary processes and muscle. The choroid is a vascular, thin, chocolate-colored membrane, lining the sclerotica, and separated from it by the delicate membrana fusca. The choroid itself has three layers—an *outer*, consisting chiefly of blood-vessels (vasa vorticosa) and pigment-cells; a *middle* layer, of fine capillary vessels (Ruysch's layer); and on the inner surface of the last tunic a faintly fibrous membrane—the *lamina vitrea*—which separates it from the pigment layer of the retina. The ciliary processes

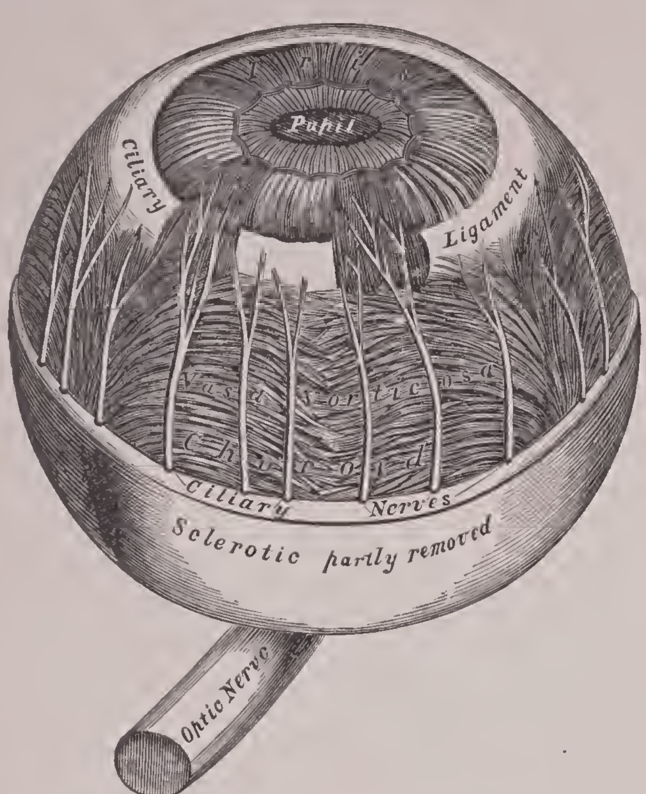


FIG. 1.—Choroid and iris.

are folds or plaits running forward from the choroid to the suspensory ligament of the crystalline lens. They number about seventy. The iris (rainbow) takes its name from its various colors in different persons. It is a colored curtain perforated by a circular aperture, the *pupil*, suspended in the aqueous humor. It is placed vertically in advance of the choroid and ciliary body, with which it is continuous. It is also connected with the adjacent border of the sclerotic and cornea by the ciliary muscle and a ligament called the *pectinate* ligament. It contains both circular and radiating involuntary muscle-fibers and a stroma of fibers and cells and pigment-cells. The circular sinus is a canal (Schlemm's) which runs around the eye outside the ciliary body. The ciliary muscle is a circular band of involuntary muscle-fiber which passes back from the junction of the cornea and sclerotic to the choroid. It is through the action of this muscle on the crystalline lens that the eye is accommodated or adapted to distinct vision at different distances.

The retina is a delicate nervous membrane which receives the images of external objects. Behind, it is continuous with the optic nerve; in front it extends nearly as far forward as the ciliary ligament, where it is termed the *ora serrata*. In the center of its posterior part, at a point corresponding to the axis of the eye, there is a yellowish spot called the *macula lutea*, having it in a central depression, the *fovea centralis*. At this point the sense of vision is most perfect. The retina is very complex and is composed of ten layers, named from within outward as follows: The *internal limiting membrane, the nerve-fiber layer, the nerve-cell layer, the inner and outer granular and nuclear layers, the external limiting membrane, the layer of the rods and cones,* and *the pigmentary layer*. The internal limiting layer is in contact with the hyaloid membrane of the vitreous humor. The nerve-fiber layer is continuous with the optic nerve. The layer of the rods and cones is often called Jacob's membrane, or the bacillary layer. The rods are solid, of nearly uniform size, and arranged perpendicularly to the surface. The cones are flask-shaped, their broad ends resting upon the external limiting membrane. In the region of accurate sight in Jacob's membrane, there are no rods, but only cones. The retina is supplied with blood by the central artery of the retina, which pierces the optic nerve and enters the globe of the eye through the center of the nerve, or *porus opticus*. The retinal vein accompanies the artery.

The contents of the eye are the aqueous humor, the crystalline lens, and the vitreous humor. The aqueous humor consists of about 4 or 5 grains of water, with a very small proportion of common salt and other matters in solution. It occupies the space between the cornea in front and the crystalline lens behind. This space is divided into the anterior and the posterior chambers, which the iris separates from each other. Behind the aqueous humor comes the crystalline lens, suspended in the capsule, an elastic, transparent membrane which is retained in its place by the suspensory ligament. Between this ligament and the hyaloid membrane is the space called the canal of Petit. The lens itself—a double convex body, one-third of an inch in transverse, and one-fourth of an inch in antero-posterior, diameter—consists, as is seen when it has been boiled or hardened in alcohol, of layers of transparent matter arranged in segments. The vitreous humor occupies four-fifths of the cavity of the eyeball. Like all the contents proper of the eye,

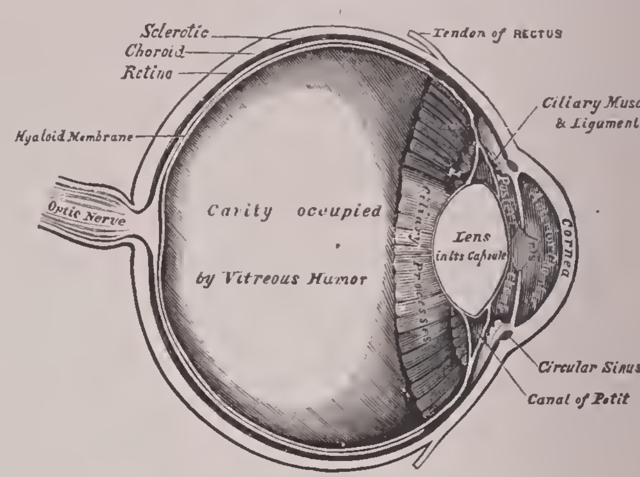


FIG. 2.—Vertical section of the eye.

it is transparent. It consists of a thin, jelly-like, albuminous fluid. When the aqueous humor has been evacuated by accident or operative interference, it is speedily restored like other serous fluids; but if the vitreous humor is entirely lost, it is never renewed. See LIGHT, VISION, and HISTOLOGY (*Organs of Special Senses*). Revised by G. E. DE SCHWEINITZ.

Eye, Diseases of: See GRANULAR LIDS, BLINDNESS, CATARACT, MYOPIA, SQUINTING, OPHTHALMIA, and VISION, DEFECTS OF.

Eye-bolt: on ships, a metal bolt screwed into the timbers or set up with washer and nut, with an eye in the outer end in which a block may be hooked.

Eyebright: See EUPHRASY.

Eyepiece: the lens or combination of lenses used in microscopes and telescopes to examine the aërial image formed at the focus of the object-glass. The ordinary eyepiece is a combination, and may be either positive or negative. The former consists of two plano-convex lenses, with their convex sides toward each other, and is used for micrometers. The negative consists of similar lenses with the convex sides turned away from the eye. Besides these, there are in use for observations of the sun a diagonal eyepiece, in which a very small percentage of the sun's light and heat is reflected from the first surface of a prism, the rest being transmitted; and Dawes's solar eyepiece, in which the light is reduced by observing only a very minute part of the solar surface.

Eyestones (in Lat. *oculi cancrorum*): the name given to two semicircular calcareous concretions which are found in the common European crawfish, in August, shortly before the molting season, in the space between the inner and outer coats of the stomach. They consist of carbonate and phosphate of lime and animal gelatin, and were formerly used in a powdered state in medicine as an antacid. They are sometimes used to remove small particles of dirt from the eyes, a method which is entirely to be condemned. They are collected in brooks in Dauphiny, near Astrakhan, and in other places in Europe, and have also been found in the Mohawk river, near Rome, N. Y.

Eylau, or **Eilau**, often called **Prussian Eylau**: a small town of Prussia; on the Pasmar; 22 miles S. of Königsberg (see map of German Empire, ref. 1–J). A great battle was fought here Feb. 8, 1807, between Napoleon, who had about 80,000 men, and the allied armies of Russia and Prussia, commanded by Gen. Bennigsen, who had fewer men, but more guns. The battle was opened early in the morning, immediately after daybreak, by a furious attack made by the French left on the Prussian right and center. But the attack proved utterly unsuccessful, and the attacking corps was all but completely destroyed. The murderous struggle was repeatedly renewed, and victory seemed to incline now to the one side and now to the other. When night closed, however, the whole allied line was pressing onward and driving the French before it. Nevertheless, the victory is generally claimed by the French, chiefly on the ground that the allied forces, which were unable to recruit their strength, were ordered to retreat from the field on the night of the battle, and to seek shelter behind the fortifications of Königsberg. After the day of Eylau, however, Napoleon spoke with much more respect of the Russians than he had done hitherto. The allies lost about 20,000, and retreated from the field, but the French loss was probably the greater. Pop. (1890) 3,446.

Eymeric, *ā*-m*ā*-reek', NICHOLAS: inquisitor; b. at Gerona, a town of Catalonia, Spain, about 1320; became a Dominican friar in 1334; was appointed by Innocent VI. to be inquisitor-general of Aragon, 1357, and became chaplain and judge of heresies to Gregory XI. at Avignon, 1371. D. at Gerona, Jan. 4, 1399. As an inquisitor his zeal was so great that he was for some years suspended from his office. He especially pursued the followers of Raymond Lully. His principal work was *Directorium Inquisitorum* (1376; published in Barcelona, 1503, in Rome, 1578; best edition 1587).

Eyre, ãr, EDWARD JOHN: explorer; b. in England in Aug., 1815. He emigrated to Australia about 1833, and began in 1840 the exploration of the unknown region between South Australia and Western Australia. In this sterile region he performed a journey of nearly 1,000 miles almost alone. He published in 1845 *Discoveries in Central Australia*. In 1862 he was appointed governor of Jamaica, where he suppressed an insurrection in Oct., 1865. He was censured and removed from his office for the execution of Gordon by court martial. John Stuart Mill and others took measures to try him for murder, but failed, Eyre being justified or excused by the British public. In 1872 the costs of his defense were refunded by the Government.

Ey'telwein, JOHANN ALBERT: civil engineer and physicist; b. at Frankfort-on-the-Main, Prussia, Dec. 31, 1764; entered the artillery, where he acquired the foundation of his future eminence. He afterward held important civil offices, and was employed on a great variety of public works. He wrote *Praktische Anweisung zur Konstruktion der Faschinenwerke an Flüssen und Strömen* (1800; 2d ed. 1818); *Praktische Anweisung zur Wasserbaukunst* (1802–08; 2d ed. 1807–21); *Handbuch der Perspektive* (1810); *Grundlehren der höhern Analysis* (1824); *Handbuch der Hydrostatik* (1826). D. in Berlin, Aug. 18, 1848.

Eyzaguirre, ā-zaă-gwee'rēe, AGUSTIN: Chilian statesman; b. at Santiago, 1766. He was one of the leaders of the movement for independence in 1810; was deputy from Santiago to the first Chilian congress, and in 1813 was a member of the governmental junta during the absence of Carrera. From 1814 to 1817 he was imprisoned by the Spaniards on the island of Juan Fernandez. During the administration of O'Higgins he took little active part in politics, being engaged in an enterprise for opening trade between Chili and India. On the overthrow of O'Higgins (Jan., 1823) Eyzaguirre was chosen a member of the executive junta. He was soon after elected vice-president, and by virtue of his office became acting president on Sept. 10, 1826. He was deposed by a military revolt four months after. D. at Santiago, July 19, 1837. H. H. SMITH.

Eze'kiel (i. e. God will strengthen): one of the greater prophets of the Hebrew Scriptures, the author of a canonical book which bears his name. He was the son of a priest, and was one of those who were carried away in one of the deportations by Nebuchadnezzar, perhaps 597 B. C. He was sent to dwell on the river Che'bar or Chaboras, a branch of the Euphrates. From that place he exercised his prophetical calling, warning and instructing the exiles, pronouncing rebukes against Jerusalem so long as it stood, and denouncing woes upon Judah's heathen neighbors for their attitude toward her in her distress. The dates given in the book cover twenty-two years, from the fifth to the twenty-seventh year of the Captivity. The book is commonly—and quite plausibly—treated in two divisions, of twenty-four chapters each; but, strictly speaking, it consists of two parts, the former (chaps. i.–xxxix.) containing prophecies delivered before and after the destruction of Jerusalem in 586 B. C.; the latter (chaps. xl.–xlviii.) containing a vision of an ideal restored Israel. In this he describes the new temple, the reformed ritual, and a redivision of the country into twelve parts, which is set forth in mathematical and geometrical descriptions. These descriptions do not apply to anything which ever existed, either before or after, and this has been a ground of much unfounded anxiety lest here should be an unfulfilled prophecy. It is evident, however, that the prophet had a vision of a restored, perfect, and ideal theocracy, and this is set forth in mathematical and geometrical arrangements which are ideally perfect, and take no note of physical circumstances. In his general tone Ezekiel is independent of Jewish dogmas. He gives fresh and true interpretations and applications of the Mosaic law, which contradict the traditional interpretations. His view of the Gentiles is also free from the severity of the traditional dogma of Israel's election. For these and other reasons there were disputes among the Jewish scribes as to the position of the book of Ezekiel in the canon. A good commentary is that by A. B. Davidson (London, 1892).

Revised by WILLIS J. BEECHER.

Ezekiel, MOSES JACOB: See the Appendix.

Ezion-geber, ee'zi-on-gee'ber, or **Ezion-gaber**: an ancient port on the Elanitic arm of the Red Sea. From this point Solomon sent a fleet to Ophir, and King Jehoshaphat also built ships here for the same destination. It probably stood near Elath, and is thought by many to have been at the northwestern extremity of the Gulf of Akabah.

Ezpeleta y Veire de Galdeano, ez-pā-lā'taă-ēe-vā-ee'rā-dā-gaăl-dā-aa'nō, JOSÉ, de: Spanish soldier and administrator; b. in Pamplona, 1740. He served in Cuba for some years, attaining the rank of brigadier; was sub-inspector-general in New Spain (Mexico), and from 1781 governor of Pensacola; from 1785 to 1789 captain-general of Cuba; and from 1789 to 1795 Viceroy of New Granada. In all these positions he was an energetic and enlightened ruler. Subsequently he served against the French in the Peninsula, attaining the rank of lieutenant-general. He was taken prisoner in 1808. D. in Madrid, Nov. 23, 1823.

Ez'ra (in Heb., help; Gr. Ἔσδρας): the name of several persons mentioned in the Bible, the most important of whom was the famous priest and scribe who went with a body of Hebrew exiles from Babylon to Jerusalem about the year 458 B. C. After that year no details are given, but he was in Jerusalem with Nehemiah in 445 B. C. (Neh. viii. 1); and again, perhaps after Nehemiah's return to Jerusalem from Babylon, subsequent to 433 B. C. (Neh. xii. 36). His reputed sepulcher is shown at a place on the Tigris, near its junction with the Euphrates. His great work was that of "Scribe of the law of the God of heaven." To him the preservation and transmission of the Old Testament are largely due. See BIBLE. Revised by WILLIS J. BEECHER.

Ezra, The Book of: called in the Thirty-nine Articles of the Anglican Church *The First Book of Esdras*, following the Vulgate. It narrates the history of the Jewish nation on their return to Jerusalem from the Babylonian captivity, and during the subsequent period of their re-establishment in the land of their fathers. It is a continuation of the books of Chronicles, and is mostly a compilation, probably by Ezra, written partly in Hebrew and partly in Aramaic, the Aramaic portion beginning at iv. 8 and extending to vi. 18. See the introduction to Ezra by A. H. Sayce (London, 1885) and by H. E. Ryle (1893).

Revised by WILLIS J. BEECHER.

F

F: the sixth letter of the English alphabet; a labio-dental voiceless spirant. As is shown by old Latin writers, it differed in power from the Greek φ, and in ancient times was doubtless a voiceless spirant, like the Greek digamma, Ϝ, from which it took its form, if not its power. The English *f* corresponds etymologically most commonly to Greek π, Latin *p*: cf. Eng. *father*, Gr. πατήρ, Lat. *pater*; Eng. *foal*, Gr. πῶλος, Lat. *pullus*. It may also represent an Indo-Europ. *q* (> Gr. κ, π, τ, Lat. *qu*, *c*); cf. Eng. *five*; Gr. πέντε; Lat. *quinque*; Eng. *wolf*, Gr. λύκος.

F in chemistry is the symbol of fluorine. F in music is the fourth degree in the ascending scale of C, major or minor, being the subdominant in that scale. The bass or F clef is placed on the fourth line of the staff, hence as a note on that line is called F, the other notes, above and below, take their names accordingly. The letter F, or *f*, is also used for *forte*, loud; and FF, or *ff*, for *fortissimo*, very loud.

Fa'am: an orchidaceous plant growing in the Mauritius, in Réunion, and in India—the *Angræcum fragrans*, highly prized for its fragrance, and long used in the same way as Chinese tea is used. Many residents in the East greatly prefer it to tea. It is aromatic, stimulant, and of very agreeable taste. It is used to some extent in France, and has reputation as an antispasmodic and an expectorant.

Fa'ba [Lat., bean]: an old genus of leguminous plants now referred to *Vicia*. It included the common bean of Europe under the name *F. vulgaris*, now known as *Vicia faba*.

Faber, Cäcilia Böhl, von: See Caballero.

Fa'ber, Frederick William, D. D.: theologian and poet; a nephew of George Stanley Faber; b. at Calverley, Yorkshire, England, June 28, 1814; graduated at Oxford in 1836; became fellow of University College in 1837; vicar of Elton in 1843; went over to the Roman Catholic Church in 1845; founded the Oratory of the brotherhood of St. Philip Neri in London in 1849; and in 1854 removed with it to Brompton, London, where he died Sept. 26, 1863. He wrote a considerable number of books, both controversial and devotional, in support of the Church of his adoption, but will be longest remembered as the author of some exquisitely beautiful hymns, equally admired by all communions. The first edition of his hymns, few in number, appeared in London in 1848, and the 5th ed., containing 150 hymns, in 1862. See his *Life and Letters*, ed. by J. E. Bowden (London, 1869; 2d ed. 1888).

Faber, George Stanley, D. D.: English theologian; b. at Calverley, near Bradford, Yorkshire, Oct. 25, 1773; graduated at University College, Oxford, in 1793, and was prebendary of the cathedral of Salisbury in 1831, and master of Sherburn Hospital, near Durham, 1832; d. there Jan. 27, 1854. Author of *Horæ Mosaicæ, or a View of the Mosaical Records with Respect to their Coincidence with Profane Antiquity and their Connection with Christianity* (Bampton Lectures, 2 vols., Oxford, 1801; 2d ed. 1818); *Prophecies that have been Fulfilled* (1807; 5th ed. 3 vols., 1814–18); *Difficulties of Infidelity* (London, 1824); *Difficulties of Romanism* (1826; 3d ed. 1853); *Origin of Expiatory Sacrifice* (1827); *The Vallenses and Albigenses* (1838), etc. See memoir by F. A. Faber, in G. S. Faber's *Many Mansions* (1854).

Faber, Jacob Jacobus Stapulensis, or Jacques le Fèvre d'Estaples: the greatest of the "Reformers before the Reformation" in France; b. at Estaples, near Amiens, about the year 1450, and died at the court of Margaret of Navarra, 1536 or 1537. His translation of the New Testament appeared in 1523, and of the Old Testament in 1528. He published also several commentaries. See *Life* by C. H. Graf (Strassburg, 1842).

Faber, John: a Dutch mezzotint engraver and one of the earliest workers in mezzotint, who died at Bristol, England, in May, 1721; the father of another John Faber, an excellent mezzotint engraver, b. in 1684, who produced portraits of the Kit Cat Club and the Hampton Court beauties. D. in 1756, probably in London.

Faber, Tanaquil: See Le Fevre.

Fabi'ola: a Roman matron of the Fabian gens, who founded the first Christian hospital in Rome. After being divorced from her worthless husband she married another; but after his death she came to consider her course sinful, and after public penance devoted her wealth and her time to the care of the sick. She died in Rome, 399 A. D. The procession at her funeral was compared by Jerome to the triumphs of Scipio and Pompey. See Eng. trans. *Jerome* (New York, 1893), Ep. lxxvii. (pp. 157–163), which is really a eulogistic memoir.

Fa'bius Max'imus Verruco'sus, Quintus, surnamed Cunctator (delayer): Roman consul; attained the consulate for the first time 233 B. C.; became dictator in 217. Contending against Hannibal the Carthaginian, he adhered so closely to the policy of defensive warfare that his opponent could gain no advantage, and his successes of this sort, long continued, secured for him his surname. His is one of the most illustrious names in Roman history.

Fa'bius Pic'tor, Quintus: the earliest Roman historian; a member of the patrician family of the Fabii. He lived at the time of the Second Punic war (which began B. C. 218), though the dates of his birth and death are unknown. The last distinct notice of him is that of his being sent as an ambassador to Delphi after the battle of Cannæ, B. C. 216. He wrote a history or annals of Rome (the name is not given) from the early settlement of the city to his own times, and his work is often quoted by Livy, Dionysius, and Polybius, and once by Diodorus. He has been charged with great carelessness and perversion of the truth, especially in the earlier portions of his work. But both Livy and Dionysius draw freely from him, and frequently commend his fidelity; and Polybius, who is his severest censor, uses his materials in his own account of the Second Punic war (in which Fabius was an actor), though charging him with carelessness and partiality for the Romans. His work was written in Greek, but it is supposed there existed also a Latin translation of it. Among modern writers Fabius has found a defender in the historian Niebuhr in his lectures on the history of Rome. The fragments of Fabius Pictor are collected, and the events of his life given, by Krause, *Hist. Rom. Fragmenta* (Berlin, 1833); by Müller, *Hist. Græc. Fragm.* (vol. iii., pp. 80–92); and H. Peter, *Hist. Rom. Fragmenta* (Leipzig, 1883), pp. 6–31. See also Gerlach, *Geschichtschreiber der Römer* (Stuttgart, 1855).

Revised by M. Warren.

Fabius River: a river of Missouri; rises by several forks, and flows into the Mississippi nearly opposite Quincy, Ill. The course of the main stream is short. The North Fabius, the longest fork, rises in Iowa.

Fables [viâ Fr. from Lat. *fa'bula*, deriv. of *fari*, speak]: originally, stories of any kind; thus Dryden's *Fables* (1700) consist merely of tales from Homer, Ovid, Boccaccio, and Chaucer; later it came to mean Beast-fables (*q. v.*), and sometimes short moral tales similar in style to beast-fables.

Fabliaux, fă̆'bli-ō', or, better, **Fableaux** [Fr. plur. of *fabliau*, *fableau*, which is a singular formed from *fabliaus*, *fableaus*, the latter being the forms of the obj. plur. of Old Fr. *fablel*, dimin. of *fable*. See Fable]: certain short stories in verse composed by French *trouvères* in the twelfth, thirteenth, and fourteenth centuries. The *fableaux* purport to be stories from real life, and are to be carefully distinguished from legends, romances, and didactic poems. Their sole aim was to amuse, and they are consequently usually comic and often gross. Many of them, however, are masterpieces of narrative. The great collection of *fableaux* is that of A. de Montaiglon and G. Raynaud, *Recueil général et complet des Fabliaux des XIIIᵉ et XIVᵉ Siècles* (6 vols., Paris, 1872–90). See also French Literature.

G. L. Kittredge.

Fabre, Edward Charles: Roman Catholic archbishop; b. at Montreal, Canada, Feb. 28, 1827; educated at the College of St. Hyacinthe and seminary of Issy, France; ordained priest in 1850; consecrated Bishop of Montreal in 1876, and archbishop in 1886. D. there Dec. 30, 1896. He founded an institution for the deaf and dumb at Montreal, and has been distinguished as a pulpit orator.—His brother, Louis K. Hector, was born at Montreal, Aug. 9, 1834; educated at the Colleges of St. Hyacinthe and St. Sulpice; admitted to the bar in 1856. He edited *L'Ordre* and *Le Canadien* newspapers; in 1869 founded *L'Événement*, Quebec, and was its editor and proprietor. Among his published works are *Esquisse biographique sur Chevalier de Lorimer* (Montreal, 1856); *Canadian Literature* (1866); and *Confederation, Independence, Annexation* (Quebec, 1871).

Neil Macdonald.

Fabre, faab'r, François Xavier Pascal: painter; b. at Montpellier, France, Apr., 1766; wrought at Rome and Florence. His best works are *The Judgment of Paris*, *The Preaching of John the Baptist*, and a portrait of Alfieri. He left to the city of Montpellier his collection of works of art, and the local museum, which is large and important, is named in honor of him Musée Fabre. D. at Montpellier, Mar. 12, 1837.

Fabre, Louis Hector, C. M. G.: journalist; b. in Montreal, Canada, Aug. 28, 1838; educated there and at Paris. He has been manager of *L'Événement*, Quebec; editor of *Le Canadien* and *L'Ordre*; commissioner-general for Canada in France; and a member of the Dominion Senate. He is an officer of the Legion of Honor, France; and in 1886 was constituted a Companion of the Order of St. Michael and St. George. Neil Macdonald.

Fabre, faab'r, Marie Joseph Victorin: poet and orator; b. at Jaujac, France, July 19, 1785; wrote a *Eulogy on Corneille*, prose (1808), which was crowned by the French Institute. Among his works are *Death of Henry IV.*, poem (1808); *Ode on Tasso*; *Eulogy on Montaigne* (1812); and *Literary History of France in the Eighteenth Century* (1810). D. May 29, 1831.

Fabriano, Gentile da: See Gentile.

Fabriano, faa-bree-aa'nō: town of Italy; province of the Marches; 38 miles S. W. of Ancona (see map of Italy, ref. 4–E); especially known for its paper-mills, established in the sixteenth century. It contains a cathedral and a museum. Pop. 7,800.

Fabrice, faa'brees', Georg Friedrich Alfred, von: Saxon soldier and statesman; b. at Quesnoy-sur-Deule, France, May 23, 1818; entered the Saxon service in 1834; became a member of the staff in 1850; was chief of the staff to the troops in Schleswig-Holstein in 1863 and 1864, and to the Crown Prince of Saxony in 1866, during the Bohemian campaign, in which position he distinguished himself greatly, though the latter campaign could boast of no victory; became Secretary of War Oct. 1, 1866, assuming the great task of reorganizing the Saxon army after the Prussian pattern; commander-in-chief of the army of occupation in France in 1871. In 1871 he was again made Minister of War for Saxony, and in 1876 Prime Minister and Minister of Foreign Affairs; created count, 1884. D. Mar. 25, 1891.

Revised by C. H. Thurber.

Fabric'ius, Johann: theologian; b. at Altorf, in Saxony, Feb. 11, 1644; Professor of Theology at Altorf in 1677 and at Helmstedt in 1697. King Charles of Spain, afterward Emperor of Germany under the name of Charles VI., proposed marriage to the Princess Elizabeth Christine of the house of Brunswick, and wished her to embrace the Roman Catholic faith. Fabricius published a *Gutachten*, showing that it was proper, and even her duty, to renounce her Protestant faith to become Queen of Spain and Empress of Germany. The Elector of Hanover, afterward George I. of England, disliked this *Gutachten*, and in 1709 Fabricius was removed from his chair at the university. D. at Helmstedt, Jan. 29, 1729. Revised by Henry E. Jacobs.

Fabricius, Johann Albert: classical scholar; b. in Leipzig, Nov. 11, 1668. He is chiefly known by his *Bibliotheca græca seu notitia scriptorum veterum græcorum* (1705–28; 4th ed. in 12 vols., and index by G. Chr. Harles, 1790–1809); *Bibliotheca Latina* (1697; 3d ed. in 3 vols. by Joh. Aug. Ernesti, 1773); *Bibliotheca latina mediæ et infimæ ætatis* (5 vols., 1734); *Bibliotheca antiquaria* (1713). Of these monumental store-houses of erudition the first mentioned is still an indispensable source of information. D. in Hamburg, as Professor of Rhetoric and Moral Philosophy, Apr. 30, 1736. See H. S. Reimarus, *De vita et scriptis Fabricii* (Hamburg, 1737). To theologians he is known by his collections of the apocryphal and pseudepigraphical literature (2 vols., Hamburg, 1703–13) and his *Lux evangelii* (1731).

Alfred Gudeman.

Fabricius, Johann Christian: entomologist; b. at Tondern, in the duchy of Schleswig, Jan. 7, 1745; studied natural history at Copenhagen, Leyden, Edinburgh, Freiberg in Saxony, at Upsal under Linnæus (of whom he became an enthusiastic disciple), and was appointed Professor of Natural Science in 1775 at the University of Kiel. Entomology was his favorite study, and his *Systema Entomologica* (4 vols., Copenhagen, 1775), *Philosophia Entomologica* (1778), and *Supplementum Entomologiæ* (1797) are his principal works. An utterance of Linnæus led him to establish the structure of the mouth as the principle of division in the entomological system, and he worked out this idea with great energy and enthusiasm. He undertook every year extensive pedestrian trips in different parts of Europe, studying the world of insects in nature and in the museums; and his writings are rich in observations. D. at Kiel, Mar. 3, 1808.

Fabrizio, faa-breet'see-ō, Geronimo: anatomist and surgeon; b. at Acquapendente, Italy, in 1537; was professor at Padua; wrote treatises on anatomy and surgery, and had for a pupil Dr. Harvey, whose discovery of the circulation of the blood was suggested by some observations of his teacher upon the valves of the veins. D. in May, 1619.

Fabro'ni, or **Fabbroni**, Angelo: biographer and Latin scholar; b. at Marradi, Italy, Sept. 25, 1732; published *Lives of Italians Eminent for Learning who Flourished in the Seventeenth and Eighteenth Centuries* (20 vols., 1778–1805); was prior of the church of San Lorenzo, Florence, 1767; is sometimes called the "Plutarch of modern Italy." D. at Pisa, Sept. 22, 1803.

Fabroni, or **Fabbroni**, Giovanni Valentino Mathias: scientist; b. at Florence, Feb. 13, 1752; studied natural science in his native city and in France and England; was appointed director of the physical cabinet of the Grand Duke of Tuscany, and went in 1798 to Paris as a member of the committee assembled in that city for the establishment of unity between the French and Tuscan weights and measures. While Tuscany was under French rule, Fabroni occupied a very conspicuous position both socially and politically, and performed with success many difficult tasks, both scientific and diplomatic. He constructed the bridge across the Dora Baltea, and the road across Mont Genèvre leading from the Sardinian province of Susa into the French department of the Hautes-Alpes, at an elevation of 6,500 feet. After the restoration of the house of Lorraine in Tuscany, in 1815, Fabroni retired to the chair of Natural Science at the University of Pisa. D. at Pisa, Dec. 17, 1822. His writings are on political economy, natural science, agriculture, education, etc.

Façade, fa-saad' [Fr., from Ital. *facciata*, deriv. of *faccia* < Lat. *fa'cia*, *fa'cies*, face]: one of the sides of a building viewed from without, especially the principal front. When applied to the other faces of a building it is used with some qualifying term, as *lateral façade*, *court façade*, etc.

Facatativá, faa-kaa-taa-tee-vaa': a town of Colombia; in the northwestern part of the department of Cundinamarca; about 20 miles N. W. of Bogotá, with which it is connected by railway (see map of South America, ref. 2–B). It is 8,500 feet above the sea. The river Facatativá here passes underground for some distance. Near the town there are various interesting antiquities, including some curious sculptured rocks. The place is an active commercial center, the trade from Bogotá to the Magdalena passing through it. Facatativá was a stronghold of the Zipas, or chiefs of the Chibcha Indians; Triquesupa, the last of the Zipas, was killed here in 1538. Pop. about 8,000. Herbert H. Smith.

Faccio, faat'chō, Franco: composer and conductor; b. at Verona, Italy, Mar. 8, 1841 (or 1840); started in life as a hotel waiter; studied music in the Milan Conservatory; made his first appearance as an opera composer Nov. 10, 1863, at La Scala, Milan, with his *I Profughi Fiamminghi*, following with *Amleto* in Geneva in 1865 to a libretto by Boito. He was appointed Professor of Harmony in 1868, and subsequently of Fugue and Counterpoint in the Milan Conservatory, and in 1872 succeeded Terziani as conductor of La Scala. D. July 21, 1891. D. E. Hervey.

Facciolati, fäat-chō-laa'tē, or **Facciolato**, GIACOMO: philologist; b. at Torreglia, near Padua, Italy, Jan. 4. 1682; was Professor of Logic in the University of Padua, 1722; published an edition of the *Lexicon Septem Linguarum* of Ambrogio Calepino, an Augustine friar of Calepio (2 vols., Padua, 1731), of the Greek lexicon of Schrevelius (Padua, 1715–19), and of the *Lexicon Ciceronianum* of Nizolius (Padua, 1734). He began a Latin lexicon, finished by Forcellini. D. at Padua, Aug. 27, 1769. See FORCELLINI.

Face [Fr., from Lat. *fa'cies*]: the front part of the human head, extending from the line of the hair on the forehead to the chin, and including the forehead, eyes, nose, cheeks, mouth, and chin, as distinguished from the posterior part of the head constituting the brain-case, or cranium. The face is composed of a solid bony foundation or skeleton, upon which lie numerous muscles, blood-vessels, nerves, and other structures, interspersed with a varying amount of fat, all of which are covered by the integument. The bones of the face, as grouped by anatomists, are fourteen in number, of which twelve (constituting the nasal, superior maxillary or upper jaw, lachrymal, malar or cheek, palate, and inferior turbinate bones) are in pairs, while two (the vomer and inferior maxillary or lower jaw bones) are single bones. Of the fourteen different bones entering into the structures technically regarded as included within the face, but seven (the nasal, superior maxillary and malar bones, and the inferior maxillary bone) take part in forming the facial surface; in addition to these, the frontal bone, although classed with the cranial group, contributes the important part of the osseous basis of the face supporting the forehead. Of all these bones but one, the inferior maxillary or lower jaw, is movable, this being attached by ligamentous structures in articulation with the temporal bones, at each side of the cranium. The four large openings which appear in the skeleton of the face (the orbits, nasal orifice, and interdental cleft) are partially or wholly closed by the soft parts occupying or surrounding them, which are respectively the eyes and their appendages, the nasal cartilages, and the lips.

The general character of the face, as expressive of the higher or lower grades of intelligence, is very largely influenced by the relative prominence of certain of its bony parts. Thus the large ample forehead, with well-developed bosses, usually accepted as indicating intellectuality, is directly dependent upon the development and expansion of the frontal bone; deep-set or sunken eyes are principally caused by the projection of the superciliary arches supporting the eyebrows, although depression of the root of the nose, and the narrowness of the aperture between the eyelids contribute to this appearance; the effect of undue prominence of the malar or cheek bones is familiar in the characteristic facial type of the races of Eastern Asia, and also, to an exaggerated degree, in the Eskimos; protrusion of the upper and lower jaws is also an important factor in modifying the general character of the face.

In order to facilitate comparison, certain lines have been agreed upon, whose measurements and mutual relations shall express definite types of face, in the same way that cranial measurements supply data for the comparison of skulls. Camper long ago suggested the use of certain planes in the study of the bony parts. For the purposes of craniometric investigations his methods have been supplanted by the more accurate and elaborate measurements carried out by Broca, Turner, and many other anatomists; but Camper's lines afford a useful and readily applied means of obtaining suggestive data in the comparison of faces. Many accurate measurements which may be made on the skull evidently can not be taken on the living subject; two useful lines, however, can be readily established: (*a*) the *horizontal line of Camper*, passing across the external canal of the ear and the base of the nostril; and (*b*) the *facial line of Camper*, extending obliquely from the most prominent central point of the forehead (glabella) to the anterior surface of the incisor teeth, intersecting the horizontal line at a point coinciding, in whites, with the nasal spine. The angle included between these lines is the *facial angle* of Camper, which in the intellectual races exceeds 80°, while in those of low intelligence it is much lower; in Negro, 60°–65°; gorilla, 31°.

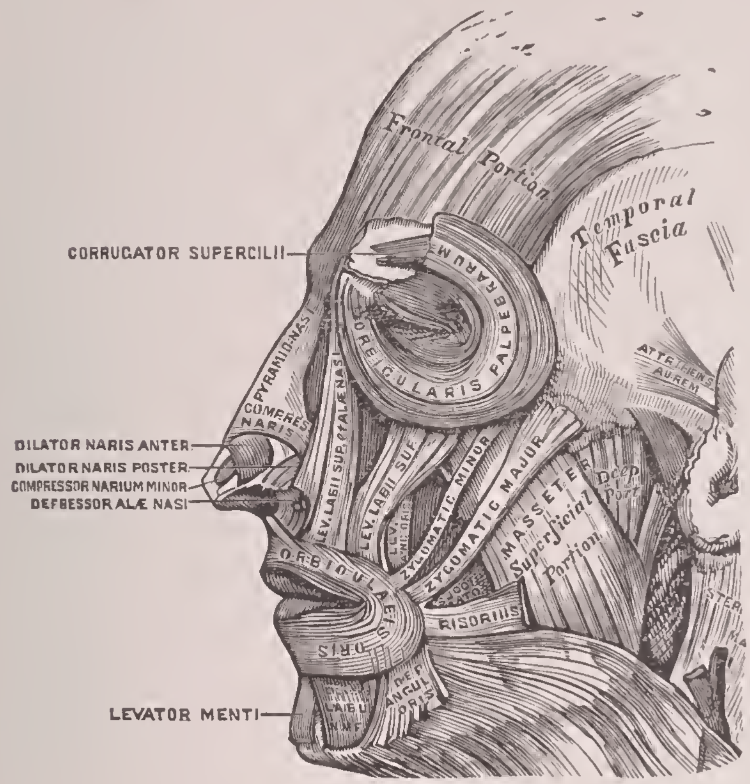
With regard to the general form, when observed in profile, faces may be divided into two groups: the one, *prognathous*, in which the facial line is very oblique, the lips large and everted, and the jaws very projecting; this is the Negro type, and is usually associated with a low degree of intelligence. The other, *orthognathous*, in which the facial line approaches the vertical, the lips are thin and small, and the jaws and line of the chin unprojecting; this is the European type, and is regarded as indicative of high intellect. Countenances may also be arranged in two other classes, according to the prominence of the central or lateral parts of the face. In the European type the middle of the face projects, while its narrow sides recede; in the Mongolian type, on the contrary, the central parts are flat, while the sides are wide and protruding, with prominent cheek-bones. Likewise, faces differ as to their *vertical* length, producing the long-faced and short-faced types, of which the Eskimos and Negritos respectively are examples.

The relation between the greatest width of the face, as measured on the skull just behind the cheek-bones—the *bizygomatic diameter*—and its length, as taken from a median point a little above the orbits (corresponding to the middle of the transverse line connecting the narrowest parts of the forehead) to the sockets of the upper middle incisor teeth—the *supraciliary-alveolar length*—has been accurately expressed by Broca's *facial index*, obtained by the formula, $\frac{\text{Supraciliary-alveolar length} \times 100}{\text{bizygomatic diameter}}$ = facial index. Broca found that 65·9 represents the average facial index for the European skull.

The character of the nose is also an important element in determining the race peculiarities of countenance. Among the points of comparison are the depth of the hollow at the root; the arching of the nose, as seen in the aquiline type so characteristic of certain races; the flattening of the nose, whether due to the participation of its entire skeleton or only of its cartilages; the form of nostril; the direction of the plane of the entire base. The peculiarities of the position and length of the eyelids largely account for the apparent obliquity of the eyes in the Mongols and other races.

In addition to the fixed anatomical causes producing variation of countenance when in repose, among which most potent are the conformation of the forehead, shape of the eyelids, prominence of the eyeballs, the nostrils, the lips, and the chin, the *movements* of the facial surface continually wrought by the constant play of the muscles induce the changes collectively known as "expression," which play so important a *rôle* in reflecting and revealing psychical processes. The muscles of the face constitute the immediate agents in producing such facial changes, whether the contractions result entirely from the exercise of the will or whether they occur unconsciously in association with certain mental conditions. The facial muscles are divided into two groups: those concerned in moving the jaw, hence called *muscles of mastication*, and those of *expression*. The latter differ from the majority of other muscles of the body in passing from their bony attachments to be fixed to soft parts, principally the skin, and in being loose in structure and poorly defined, mingled with fat and areolar tissue. They not only vary in development in different persons, but also on the two sides of the face of the same individual.

The muscles of expression may be conveniently grouped into (1) those which surround the eye; (2) those which move the nostrils; (3) those which encircle or are attached about the mouth. With the first or *orbital group* may be conveniently included the important muscle of the forehead (the frontal portion of the occipito-frontal) which is closely related to the other members of this group. The *frontal muscle* raises or arches the eyebrow and the skin over the root of the nose and throws the integument of the forehead into transverse wrinkles; the expression of surprise follows its moderate action, while fright or horror is depicted by its more violent contraction. The circular muscle of the eyelid, the *orbicularis palpebrarum*, completely encircles the cleft of the lids and surrounds the margins of the orbit, being the principal agent in closing the eyelids; two portions of the muscle are recognized: the *palpebral* portion, contained within the eyelids, whose action is involuntary and gently closes the lids, as in sleep or winking, and the *orbicular* part, surrounding the orbit, by which the eyelids are voluntarily forcibly closed and contracted. The orbicular muscle also acts powerfully in the expression of certain emotions, in laughing and crying, gathering up the skin into folds about the eye, which is thus more or less closed. The frowning muscle, the *corrugator supercilii*, is a little muscular slip extending obliquely upward and outward from the inner end of the ridge of the eyebrow; by its contraction it draws the eyebrow downward and inward, producing vertical wrinkles on the forehead expressive of perplexity, displeasure, or suffering. The *nasal* group includes a number of small muscular bands which pass in various directions, and by their actions subject the movable parts of the nose to compression, dilatation, depression, and elevation; many



Muscles of the face.

of these muscular slips are also connected with surrounding structures, so that their contraction affects other adjacent parts of the face. The small muscle passing from the inner margin of the orbit to the upper lip and wing of the nose, *the elevator of the upper lip and nose*, is the principal agent in expressing disgust and indignation; while the *dilators of the nose* enlarge the nasal apertures and are active in intense emotions, as in anger or pain. The *oral group* comprises numerous muscles, whose foci of attachment are the angles of the mouth, where they are joined to the muscular ring which surrounds the labial opening and supplies the fibers which close the mouth with greater or less force, and antagonize the muscles retracting its borders. Toward the angle of the mouth converge, from above, the *elevator of the angle of the mouth* and the *larger zygomatic* muscles, while the *elevator of the upper lip* and *smaller zygomatic* muscles are attached to the lip nearer the median line; converging from below, the *depressors of the angle of the mouth* and *of the lower lip* oppose the corresponding muscles of the upper lip; in addition, the *elevator of the lower lip* draws this structure upward and forward, at the same time slightly elevating the chin. The muscles of the oral group are very important and active agents in producing the expressions indicative of the opposed emotions of joy and sorrow; the depressor of the angle of the mouth is especially potent as a factor in producing a sorrowful countenance. It is, however, by the concerted contraction of some and relaxation of others of these muscles, often together with those of the orbital group, that the more complicated emotions find expression; thus the arching of the lips and the depression of the oral angle, indicating contempt, pride, etc., result from the combined action of the orbicular muscle and depressor of the angle. In smiling and laughing the muscles contracting the mouth are overcome by those retracting the lips, which are further drawn up, joined with the more or less pronounced participation of the orbital group, resulting, as in excessive laughter, in narrowing the fissure of the eyelids. In grief, the muscles of the lips are combined with those of the eyebrow, the extremity of the latter being drawn upward, while the retraction of the lips and depression of the angle of the mouth result from the associated contractions of the oral group. These are but instances of the endless variety of expression which the human face is capable of depicting through the immediate agency of the facial muscles, by whose co-ordinated contraction and relaxation all shades of emotion are so effectively portrayed.

The numerous *blood-vessels* supplying the face are principally branches of the facial artery, the main channel through which the blood is conveyed. This vessel is derived from the principal trunk at the side of the head, the external carotid, enters the face by winding over the lower border of the jaw, not far from its middle, and crosses the face obliquely to the side of the nose, along which it passes as far as the inner corner of the eye; in its course it gives off branches which supply the cheeks, chin, lips, and nose. Additional blood is brought to the face by the transverse facial and infraorbital arteries. The venous blood is returned chiefly by the corresponding facial vein.

The *nerves* distributed to the face are, as in other parts of the body, of two kinds—those of motion, for the control of the numerous muscles, and those of sensation, devoted to maintaining common sensibility. The former are principally derived from *the facial nerve*, although the muscles of mastication are supplied by the motor division of the trifacial; the nerves of sensation are chiefly branches of the great trifacial, whose principal cutaneous branches reach the surface just at the upper margin of the orbit—*supraorbital*; below the eye, where nose and cheek meet—*infraorbital*; at the side of the chin—*mental*; and in front of the ear at the side of the head—*temporal*; from these foci numerous twigs ramify in all directions, uniting with filaments from adjacent centers. A narrow zone along the lower margin of the jaw, however, forms an exception to the general facial surface, deriving its sensory nerves from the cutaneous branches of superficial cervical and great auricular nerves of the neck. G. A. PIERSOL.

Facet [from Fr. *facette*, dimin. of *face*, face]: one of the plane surfaces cut upon precious stones to increase their luster. The planes which bound a crystal, the flat surfaces of the cornea of an insect's eye, and in fact any minute plane surface may take this name.

Facetiæ, fā-see'shi-ē̆e [Lat., deriv. of *face'tus*, well-made, elegant, witty, deriv. of *fa'cere*, to make]: a collection of humorous sayings, witty stories, *bons mots*, repartees, in prose and verse. From the ancients nothing has come down except the *Jests of Hierocles*, the sayings and doings of one "Scholasticus," the typical blunderer of earlier times, the prototype of the modern perpetrator of "bulls." The earliest specimen in modern times is the *Liber Facetiarum* of Poggio Bracciolini (1st ed. Rome, 1470). The term as used in modern bibliography is limited to books or plates of an obscene character.

Facial Angle: See FACE.

Facial Nerves: The nerves of the face. The motor nerve of the face (the facial nerve proper) is also called the seventh or portio dura of the seventh according as to whether the cranial nerves are regarded as being twelve or nine in number. Its nucleus is in the floor of the fourth ventricle. Its superficial origin is from the lateral tract of the medulla oblongata in the depression between the olivary and restiform bodies immediately behind the pons. It passes forward and outward upon the cerebellar crus and enters the internal auditory meatus, at the bottom of which it enters the aqueductus Fallopii, along which it passes through the petrous portion of the temporal bone and emerges at the stylomastoid foramen. It passes forward through the parotid gland, and behind the ramus of the lower jaw divides into two primary branches—the temporo-facial and the cervico-facial. The divisions of the nerve in the parotid gland somewhat resemble a bird's claw, and hence this portion of it is called *pes anserinus*. All the muscles of expression in the face, as well as the buccinator, platysma, stapedius, lingualis, retrahens aurem, stylohyoid, and the posterior belly of the digastric are supplied by it.

The trifacial (*trigeminus*) or fifth is the sensory nerve of the face. It contains also motor fibers, and is possibly, to a certain extent, a nerve of special sensation. It arises superficially from the side of the pons Varolii. It has two roots—an anterior or motor and a larger posterior or sensory one—upon which is a ganglion (the Gasserian) precisely as in the spinal nerves. There are three main branches—the ophthalmic, the superior maxillary, and the inferior maxillary. The first is purely sensory. It supplies the eyeball, the lachrymal gland, the mucous lining of the eye and nasal fossa, and the skin and muscles of the eyebrow, forehead, and nose. The second is also sensory, and supplies the side of the nose, the lower eyelid, and upper lip. The third branch is made up of two parts, a larger sensory division which supplies the teeth and gums of the lower jaw, the skin of the temple and external ear, the lower part of the face, and lower lip. It also sends a large branch to the tongue which probably serves as a nerve of taste. The motor branch supplies the muscles of mastication—the masseter, temporal, and pterygoids.

WILLIAM PEPPER and C. W. BURR.

Facial Neuralgia: trigeminal neuralgia; tic douloureux; prosopalgia. (For causation, see NEURALGIA.) The fifth nerve is more often the seat of neuralgia than any other. While the nerve may be affected throughout its entire distribution, more frequently one or two of the three main divisions are involved, or it may be one only of the smaller branches. It practically never occurs on both sides at once. When the ophthalmic division is affected the pain is felt above the brow. So commonly is this due to malaria that it is often called "brow ague." The eyeball may be the seat of pain, sometimes accompanied by dimness of sight, contraction of the field of vision, and flashes of light. When the superior maxillary division is affected, the pain extends from the orbit to the mouth, over the cheek, and to the side of the nose. If the inferior maxillary be involved, the pain is felt in the side of the head, the temple, ear, lower jaw, and tongue. Sometimes there is a boring pain limited to a point in the temple, and occasionally the tongue alone is affected (glossalgia). The pain is intense, at times making life almost unbearable, and so increased by movement of the jaw as to render eating almost impossible. It may radiate from one division of the nerve to the next or even to other nerves. If the onset be sudden and severe, reflex muscular spasm may occur (tic convulsif). Palsy is rare, but there is often flushing, local sweating, increased nasal and buccal secretion, and lachrymation. In chronic cases there may be thickening of the periosteum and hardening of the skin, loss of hair or local grayness, and herpes about the eye or lip. Pressure at the points of exit of the nerves from bony canals causes pain. Treatment depends upon causation.

WILLIAM PEPPER and C. W. BURR.

Facial Paralysis: paralysis of the muscles of the face. There are two forms—(1) central, in which the disease is situated between the nucleus of origin of the nerve and the cortex of the brain; (2) peripheral, called Bell's palsy, in which the lesion is in the nucleus or the nerve itself. In the first the upper face muscles are but little or not at all affected, and those around the mouth suffer most. Voluntary movements are much more impaired than those due to emotion. Lastly the affected muscles respond normally to electrical stimulus, or if there be any diminution it is the same for both the faradic and galvanic current. In the second form there is complete palsy of one side of the face. The onset is rapid, but not sudden. The commonest cause is inflammation of the nerve due to cold, e. g. sitting while overheated by an open, draughty window. Ear disease, especially in children, is also a frequent cause on account of the close proximity of the nerve to the auditory apparatus in its course through the petrous portion of the temporal bone. Tumors or meningitis at the base of the brain may cause palsy by pressure upon the nerve, and fracture of the base of the skull may tear or bruise it. Wounds or operations about the angle of the jaw may cut it. A blow, as in boxing the ears, may cause palsy. In instrumental delivery the nerve has been injured by pressure of the blade of the forceps. Syphilis is an occasional cause. The face in this disease is characteristic. The wrinkles are smoothed out of the forehead, the angle of the mouth droops, the cheek flaps in and out with respiration, the folds at the side of the nose disappear, the patient can not whistle or blow out a candle, and on attempting to drink the liquid runs out of the side of the mouth. Food collects between the teeth and the cheek. The tongue is protruded to one side. The eye can not be closed, and on attempting to do so it is rolled upward so that only the white is visible. All muscular effort draws the face strongly to the healthy side. In certain cases taste is lost in the anterior part of the tongue on the palsied side. Hearing may be impaired. Reaction of degeneration comes on later. Wasting may follow, but, on account of the small size of the muscles involved, is never very marked. Sensation is unaffected. The immobility of the eyelid may permit foreign bodies to settle in the eye, but the increased quantity of tears usually floats them off, and nothing more serious than a slight conjunctivitis is apt to follow. After some time contractions may set in, and, owing to the pull of the contracted muscles, the folds and wrinkles may appear again, and at first sight it may seem that the normal is the palsied side. The first indication in treatment is to remove the cause. Hot fomentations to the ear and blisters are good at the beginning. Potassium iodide and mercury have their proper place. In chronic cases electrical treatment is often very beneficial.

WILLIAM PEPPER and C. W. BURR.

Fa'cies [Lat., the face]: a term which has come to be applied to the expression, especially as indicating various forms of disease, rather than to the face itself. The old-time physician, having fewer accurate methods of investigation at hand, relied largely on the expression to discriminate between different diseases, but it still remains of considerable value as a diagnostic means to the physician. Hippocrates first described the peculiar facies of approaching death, called by his name, *Facies Hippocratica*. The sunken eyes and temples, the sharp nose, contracted ears, distended forehead and dark-hued or leaden skin are certainly characteristic of approaching death, but acute collapse may be attended by these features and yet lead to no such end. Besides this, there are recognized in many diseases features more or less indicative of the disease, and the experienced physician frequently finds little difficulty in diagnosticating cases at first sight. The peculiar dull, lethargic, expressionless face of typhoid fever, the flushed, active appearance of that of pneumonia, are rarely to be mistaken. So, too, the hard lines about the mouth and nose in severe gastric and intestinal disturbances, the pinched features, with livid eyes and muddy complexion, of a victim of cholera, and the sallow, emaciated countenance of one afflicted with cancer, are sufficiently marked to allow of a diagnosis being made by this alone.

WILLIAM PEPPER.

Factor [from Fr. *facteur* < Lat. *fac'tor*, maker, doer, deriv. of *fa'cere*, make, do]: in mathematics, one of the several measures or divisors of a number or quantity. The name is given to each of those quantities which, when all are multiplied together, will produce the *product*.

Factor: a general agent employed in the purchase or sale of merchandise, with power to retain possession of the property in regard to which his authority is exercised, and to control, to a large extent, its management and disposal by proceedings in his own name. By the possession of these peculiar powers a factor is distinguished from a broker, who only conducts negotiations and bargains concerning property of his principal, without having it in his charge, and who properly acts in a representative character by the use of his principal's name. The term "factor," though the one usually employed in law, is not so common in popular usage as "commission merchant" or "consignee." Compensation by the principal is generally a certain percentage on the amount of purchases or sales, called factorage or commission. A *domestic factor* is one who resides in the same country with his principal; a *foreign factor*, one who resides in a different country. A foreign factor, in his relations with third persons, is regarded, to a large extent, as if he were himself principal, and he is therefore under a greater responsibility than one merely domestic. In the application of this distinction the States in the U. S. are not, according to the general course of decisions, regarded as foreign to one another. The fundamental duty of a factor is to exercise reasonable care in the performance of the duties with which he is intrusted, and to exhibit such skill and prudence as is required by the nature of the business and a proper consideration for the welfare of his employer. Otherwise, he has no valid claim for his commissions, and for injurious negligence and default may even be subjected to an action by his principal. In the management of the property committed to him he has commonly extensive discretionary power. He may buy and sell, sue and be sued, collect money, give receipts, etc., in the same manner as if he were himself owner of the goods, unless specially restricted by the principal. If any special instructions are given to guide his action, he is bound, as between him and his principal, to follow them strictly, except in some few cases where the necessary protection of his own interests requires that such directions be violated. An instance of the latter kind occurs where the factor has made advances for his principal, and finds it necessary to sell the goods upon the credit of which the advances were made, in order to reimburse himself, upon failure or refusal of the principal to make repayment after proper notice and demand. In such a case the generally established rule in the U. S. is that the factor has a right to sell to the extent of his advances, even in opposition to the wishes of his principal. The rule in Great Britain, however, is different. Even where the factor violates special instructions, he may, in certain cases, confer a title upon a purchaser acting in good faith. In the absence of instructions, factors should conform to the usages of the business in which they are engaged, and will be justified in the adoption of any practice which such usages warrant, provided there is no wanton disregard of their employers' interests. They have a lien upon the property intrusted to them for their commissions, advances, and other proper charges, so long as they retain possession. Sometimes, in consideration of an increased commission, a factor guarantees the payment of the price of goods by the purchaser to his principal. He is then said to act under a *del credere* or guarantee commission, and is subject to most of the obligations of a surety. A factor acquires no right to his commissions until all the services for which he was engaged have been rendered. (See AGENT and BROKER.) Statutes have been passed in Great Britain and some of the U. S. regulating the rights and duties of factors in certain respects.

Revised by T. W. DWIGHT.

Factor of Safety: a number which expresses the ratio of the breaking strength of a bar or structure to the actual stress upon it. For buildings and structures subject to quiet loads the factor of safety is taken at about 15 for brick and stone, 8 for timber, 6 for cast iron, and 4 and 5 for wrought iron and steel. For bridges, and for machinery subject to shocks, much higher values are used. Factors of safety are subject to variation not only on account of the different qualities and grades of materials, but also on account of the varying judgment of designers. The factor of safety has been called a factor of ignorance, and this is the case if it be blindly assumed without knowledge of the elastic and resisting properties of materials. The tendency among engineers is to avoid the use of the term, and to establish the proper working stresses for materials from the knowledge of such properties. See STRENGTH OF MATERIALS.

MANSFIELD MERRIMAN.

Factories and **Factory System** [*factory* is from Fr. *factorie*, from deriv. of Lat. *factor*, maker, manufacturer. See FACTOR]: buildings appropriated to the manufacture of goods, and the system of production therein employed. A factory has been created and "the factory system" has been evolved when goods are produced through consecutive processes carried on as a harmonious whole, by laborers congregated in works especially adapted for this purpose, and provided with productive machines actuated by some central motive power. Dr. Ure, in his *Philosophy of Manufactures*, has stated that "the factory involves, in its strictest sense, the idea of a vast automaton, composed of various mechanical and intellectual organs acting in uninterrupted concert for the production of a common object, all of them being subordinated to a self-regulated, moving force." A factory, then, to give an enlarged definition, is an establishment where several workmen are collected for the purpose of obtaining greater and cheaper conveniences of labor than they could procure individually in their homes, for producing results by their combined efforts which they could not accomplish separately, and for preventing the loss occasioned by carrying articles from place to place during the several processes necessary to complete their manufacture.

The factory system of manufacture has displaced the domestic or hand system of labor. It is applied to almost every branch of mechanical production, and its application is being constantly extended. It will probably become essential in what is known as the "extractive" industries. In many localities mining is more of a manufacture than anything else, being carried on by means of mechanical processes involving a central power. The birth of the factory system is easily assigned to the decade 1760–70, for it was during this period that the *régime* of machinery began. The spinning-frame, the spinning-jenny, and subsequently the mule spinning-machine were inventions on which the introduction of the factory system depended; but the system would not have grown at once to any very great proportions from the sole influence of these inventions. The extension of the canal system of transportation, the various improvements in the steam-engine, the suppression of the slave-trade diverting a great volume of capital which sought remunerative investment, the war between Great Britain and her colonies in America, the political economy of Dr. Adam Smith—all these were influences or forces which, combined, resulted in supplanting the domestic or hand-labor system of Great Britain by the factory system of labor. In the U. S. the domestic system of labor prevailed when the war of Independence closed, for the influence of inventive genius had not yet affected labor. On the opening of the ports of the new nation the market was fully supplied by British products. This caused a new fever of patriotism, which resulted in efforts to transplant the inventions which were becoming powerful in revolutionizing labor in Great Britain. The series of inventions relating to textiles was completed when the power-loom was invented; but Great Britain sought to prevent its use, as well as the use of other inventions, in the United States, through enactments prohibiting the exportation of machinery. The associations formed in the colonies for the purpose of inducing the people to purchase domestic productions only were a great assistance to the pioneers in manufactures, but this influence was increased or supplemented by the action of the Continental Congress through the resolutions relating to non-importation, under the influence of which the colonists could look only to their own resources for the supply of many commodities. The foundation of manufactures in North America was thus permanently laid. Many household industries were established and became profitable, and the desire of the whole people to shake off industrially, as they had politically, the yoke of the mother-country stimulated the first Congress to pay immediate attention to the promotion of manufactures, its second act, passed July 4, 1789, being an act for laying a duty on goods, wares, and merchandise imported into the U. S. While the factory system was established in the U. S. about fifteen years later than in Great Britain, the extension has been far more rapid, and many more industries have come under its operations than in the mother-country. The States of Massachusetts and Rhode Island claim together the honor of introducing power spinning-machines, and their early use in the U. S. Massachusetts is undoubtedly entitled to her claim to the first experiments in machinery in which the principles of Arkwright's inventions were embodied, and of erecting the first cotton-factory in America, and Rhode Island's claim of having erected the first factory for the use of perfected machinery comprehending the English inventions is undoubtedly valid, for Samuel Slater built a cotton factory in that State in 1790. Mr. Slater has been called the "father of American manufactures." Certainly from the date of the erection of his factory the progress in the production of goods under the factory system has been continuous. But Francis C. Lowell was the first in the world, so far as history teaches, to perfect a factory in which all the manipulations and processes necessary to carry raw material to finished goods were carried out consecutively under one directing mind. This was at Waltham, Mass., in 1813.

To give a detailed account of the history of the different industries coming under the factory system of labor would involve an article too extended for this place. An examination of the system itself and its effects in various directions is more appropriate and valuable.

The rapid extension of the factory system, absorbing as it does small enterprises and crushing out the ideal system of manufacture, has not been accomplished without great social changes, affecting the morals as well as the politics and the legislation of the countries in which it has been established. No one disputes the economic advantages of the modern system; few admit that it is a moral force in the actual progress of civilization; yet the system is, and has been, an active element in the upbuilding of the character of the peoples involved in the changes wrought by it; and it will remain until disintegration is the rule in society.

The domestic system, which claims the eighteenth century almost entirely, has not yet disappeared. The factory system is in every respect vastly superior to it as an element of civilization, although this is contrary to popular impression and largely against popular sentiment. Abuses have existed, great and abominable enough, but not equal to those which have existed in the imaginations of many. The common notion that the factory system exerts an influence for evil is largely due to the fact that it congregates evils or evil-disposed persons, and thus gives the appearance of creating that which already existed. People have not yet outgrown the impression created by the reports of Sadler before a parliamentary committee in 1832.

A factory is a scientific structure, its parts harmonious, the calculations requisite for their harmony involving the highest mathematical skill, and in the factory the operative is always the master of the machine, and never the machine the master of the operative. Under this system, the work is carried on in an establishment peculiarly adapted to it, and the operative's home is separated from the workshop. Under the domestic system, the home of the worker was the workshop also, and the wheels or looms disputed with the inmates for the room and the conveniences for housework. Small, close, crowded, with bad air and bad surroundings, the hut of the domestic worker was occupied day and night by a class which has not found and can not find its like under the factory system; for, as a rule, the operative of to-day occupies a home, even in the factory tenement or boarding-house, superior in every sense to the home of the domestic worker.

Under the domestic system of industry grew up that great pauper class in Great Britain which was a disgrace to civilization. It was fed by the agricultural districts more than by those devoted to manufactures. It continued to grow until one-fourth of the annual budget was for the support of paupers. The evil became fixed upon the social life as one of its permanent phases. Legislation, philanthropy, charity, were utterly powerless in checking it, and it was not checked until the inventions in cotton-manufactures came, since which time it has been on the decline. The factory absorbed many who had depended upon public support: on the other hand, it drew from the peasantry, by the allurements of better wages and without any guarantees as to permanence or care as to moral responsibility; yet on the whole the state was benefited more than any class was injured.

The domestic laborer's home was far from having the character poetry has given it. Huddled together in what poetry calls a cottage and history a hut, the weaver's family lived and worked, without comfort, conveniences, good food, good air, and without much intelligence. Drunkenness and theft of materials made many a house the scene of crime and want and disorder. Superstition ruled and envy swayed the workers. Ignorance under the old system added to the squalor of the homes of the workers under it, even making the hut an actual den, shared in too many instances by the swine of the family. The home of the agricultural laborer was not much better; in fact, in Great Britain and France he has to a great degree continued in his ignorance and in his degraded condition.

From the documents published by the poor-law commissioners of England, it appears that but for the renovating influence of her manufactures Great Britain would have been overrun with the most ignorant and depraved men to be met with where civilization has made much progress. It has been in the factory districts alone that the demoralizing agency of pauperism has been most effectually resisted, and a noble spirit of industry, enterprise, and intelligence called forth. Agriculturists gave children and youths no more than half the wages paid them in factories, while they filled the workhouses with the unemployed. Under the operation of the miserable poor-laws which the domestic system fathered the peasantry were penned up in close parishes, where they increased beyond the demand for their labor, and where the children were allowed to grow up in laziness and ignorance, which unfitted them for ever becoming industrious men and women. But in the chief manufacturing districts, while the condition of the factory children became the subject of legislation for their protection, their condition was one to be envied when compared with that of the children in mining and agricultural districts.

The spasmodic nature of the work under the domestic system caused much disturbance, for hand-working is always more or less discontinuous from the caprice of the operative, while much time must be lost in gathering and returning materials. For these and other obvious reasons a hand-weaver could very seldom turn off in a week much more than one-half what his loom could produce if kept continuously in action during the working hours of the day, at the rate at which the weaver in his working paroxysms impelled it. The regular order maintained in the factory cures this evil of the old system, and enables the operative to know with reasonable certainty the wages he is to receive at the next pay-day. His life and habits become more orderly, and when he has left the closeness of his home-shop for the usually clean and well-lighted factory, he experiences an agreeable and healthful change. It is commonly supposed that cotton-factories are crowded with operatives. From the nature of things the spinning and weaving rooms can not be crowded. The spinning-mules, in their advancing and retreating locomotion, must have five or six times the space for working that the actual bulk of the mechanism requires, so that in the spinning-rooms there can be no crowding of persons. During the agitation for factory legislation in the early part of the nineteenth century, it was remarked before a committee of the House of Commons "that no part of a cotton-mill is one-tenth part as crowded, or the air in it one-tenth part as impure, as the House of Commons with a moderate attendance of members." This is true to-day; the poorest factory in the U. S. is as good a place to breathe in as Representatives' Hall, in the national Capitol, during sessions, or as the ordinary schoolroom. In this respect the new system of labor far surpasses the old.

It is true that many disadvantages appear to accompany the factory system, and these, upon superficial study, are denominated evils; but a careful study shows that these apparent evils or disadvantages do not of necessity belong to the system, nor can they be attributed to it. Such study does show that existing factory evils, so called, may be congregated by it, but are not called into existence by it. For the categorical consideration of such alleged evils they may be classified as follows:

A.—Does the factory system necessitate the employment of women and children to an injurious extent, and is its tendency to destroy family ties and domestic habits, and ultimately the home?

B.—Are factory employments injurious to health?

C.—Is the factory system productive of intemperance, unthrift, and poverty?

D.—Does it foster prostitution and swell the criminal lists?

E.—Does it tend to intellectual degeneracy?

These questions indicate the apparent disadvantages which many honestly believe belong naturally to and are inseparable from the system, and which will be associated with the system as long as it exists. For the sake of directness these will be examined in order.

A.—In one sense it is true that the factory system is inimical to the home through the employment of women and children to an injurious extent; in another sense it is not true. The question as to differences in the capacity of individuals, and why this one is born to good conditions and that one to bad, can not be discussed, but the facts must be taken as they are. The majority of human beings are born to the lot of toiling with their hands for their daily bread. This decree necessitates employment, and until all classes can be employed at fairly remunerative rates poverty, even to pauperism, must be a large factor in society. This was the case at the birth of the factory system. In fact, the great evils which became apparent during the early days of the system were simply, as has been said, the results of bringing together the labor which had become pauperized under the domestic system and in agricultural districts. The factory brought these evils to light, and the employment of women and children became an offense in the eyes of the public, not because it was severer than under the old system, but because under the new the evils of such employment could be seen.

It is true that the success of the system, so far as textiles are concerned, has depended in a large degree upon such employment, and it is also true that such employment has enabled women and children to step from the ranks of degrading dependence and pauperism to the ranks of comparative comfort and the dignity which comes from self-support. In the early days of the factory the children were by their employment really placed in a much better position than they occupied before. The employment of married women is perhaps the very worst feature of factory employment, but the facts relating to it are meager. In Great Britain the proportion of married women to the whole number of women employed in textile works is unknown, but for those factories concerning which the writer has been enabled to make inquiries 10 per cent. is the average. In Germany it was found that from 20 to 50 per cent. of the textile-factory women were married. Dr. Engel gives the percentage in various industries as 24. Proprietors in both countries discourage the employment of married women. The statistics of Massachusetts show that the married female operatives constitute less than 8 per cent. of the whole number of women employed in all textile factories. Taking all textile factories into consideration, the percentage probably would not exceed 10. It is evident, then, that in Great Britain and the U. S. infant mortality is not, on the whole, affected to any great degree by the employment of married women; but it is affected seriously so far as the children of those employed are concerned. It must not be presumed that the employment of married women is the sole cause of the very high percentage of deaths under five years in factory towns compared with deaths in towns of diversified industries and agricultural towns. Crowded houses, bad sanitation, and the general effect of compact towns upon young children, especially during inclement seasons, are potent influenees in producing high rates of mortality. The statistics of factory towns in the United Kingdom do not exhibit a larger proportion of deaths of infants than occur in other large towns where few or no factories are in operation, yet the proportion is very much larger than in agricultural towns.

In Germany, according to information furnished by Dr. Ernst Engel, in a factory city in the district of Zwickau, out of 459 children born in one year, 169, or 36 per cent., died under one year of age. Of those who died it was learned that 98 had not been nursed at all, and only 32 for the full time. In another factory city in the same district, in the same year, out of 428 children born, 185, or 43 per cent., died the first year, of whom 98 were never nursed at all and only 23 for the full time, and of the remainder only two for more than twenty weeks. In a third city, 48 per cent. in 1873 and 41 per cent. in 1874 of all the children who died had not reached the age of one year, and the great majority were the children of factory operatives. In a fourth factory city, of 731 persons who died in 1874 the children numbered 510, of whom 406 were under one year of age. The attending physicians in the cities ascribed the infant mortality partly to the bad condition of houses, but mainly, without hesitation, to the fact that mothers gave their attention to the work in the factory; that natural nursing was either given up entirely or continued for only a short time; and that the children, instead of receiving a mother's care, were left to the guardianship of older children.

In the district of Liegnitz, in Prussia, the rate of mortality has decreased among small children since hand-loom weaving gave way to factory employment. At Aix, in all cases where the mothers resumed work in the factory soon after confinement, an unusual mortality occurred among the infants.

In the greater part of the districts of Bavaria the health of the factory operatives seems good. If here and there a greater mortality among infants and poor health among the older children are met with, it should not be ascribed to any special branch of industry, nor necessarily to factory work, but to the unfavorable conditions under which children belonging to the working classes, whether in the factory or out of it, are brought up.

In Swabia, the city of Augsburg alone furnishes unfavorable reports. Out of 418 children under one year belonging to the factory population, 273, or 65 per cent., died in a year; out of 1,692 infants of the remaining population, 732, or 43 per cent., died.

In Würtemberg much complaint has been made of an excessive mortality among infants, but the cause is thought to be not that the mothers are employed in the factories, but in that lack of maternal care which is notorious among the working classes of this district. According to the statistics from these districts, the mortality is often greatest in those plaees in which few women are employed in the factories, while places in which such employment is general make a favorable showing as to infant mortality. The mortality among infants in Baden and Hesse does not seem disproportionately large among the factory population.

The writer is confident, from all the testimony he has been able to gather, that there are many more children of mothers working in factories during pregnancy who die in infancy than of other classes; and that while many children die when only a few months or a year old, in eonsequence of the factory work of the mother during pregnancy, many born healthy, or apparently so, die from want of proper maternal care. He is further satisfied that the conditions of the homes of these women are as deleterious to their health, and to infants born to them, as the work of the faetory, and that to exclude such women from the factory would be an act of great injustice to those eoncerned. And yet he is satisfied that the employment of married women is the worst apparent evil of the factory system. Attempts to relieve communities of the unhappy results of such employment appear to be few in number.

Does the employment of women and children tend to destroy the home? To the extent that women who are mothers and have the care of a household, and who become careless of maternal ties through hard work and maternal duties combined, it does; the faetory mother who has buried several children learns sooner or later to speak of her losses in a careless and unfeeling manner. Domestic felicity does not and can not reaeh a very high place when a mother must arise before the rest of the family to prepare hastily the breakfast for all, then hasten to the mill and make her time good till the noon hour, when the dinner must be prepared as hastily as was the breakfast; while at night, after a day of constant labor, she must see that supper is served and then take up the thousand and one duties of the household, which keep her busy till the hour has long passed when she should be asleep. No ten-hour law has been able to reach the factory woman with a family. However, it is gratifying to be able to believe that the number of married women employed in factories is decreasing. Notwithstanding the evil results of their employment, their condition is a vast improvement upon that which surrounded the workers under the domestic system.

The home in the U. S. suffered more from the institution of the faetory system than it did in Great Britain, for there the faetory found a population ready to become faetory workers, while in the U. S. it was neeessary to provide for a new population, and this opened the way for the tenement-house and the factory boarding-house, two features of factory life which are quite unknown in Europe, and which are gradually disappearing in the U. S., while the individual home is inereasing in its influence. With this growth of the influence of the individual home there has been a gradual decrease in the employment of married women. If at times the employment of women has taken the mother from the care of her infant, it has enabled more who had no home to become self-supporting, for the employment of women generally is now no evil, thanks to improved machinery and generally wise legislation.

Young children are now almost universally excluded from the faetory and workshop. Where their age permits, they are much better off inside than outside the faetory, and their employment enables them to contribute to home support rather than to draw from the income of the family.

B.—That some factory employments are injurious to health is true, but it is not true that factory employment, as sueh, in comparison with any other meehanical employment, is unhealthful. A reeent writer, describing a watch-factory, states what is true of all factories:

"The first requisites of a wateh-factory are neatness and abundance of light. It is now recognized that no man can do his best work unless he is physically comfortable. Excess of heat or eold, poor light, and, more than all, bad air, are positive hindrances to good work. Of two men equally skilled, one in a close, damp, or hot room with a bad light, and the other in a dry, sweet, and healthful room with the best light, the man who has the most comfortable quarters will do the most and best work in a day."

It is now seen that everything that contributes to the physical and mental comfort of workmen pays a good return on the eost, and eertainly makes better citizens of the operatives. Intelligent employers of labor adopt all plans which can be devised for securing the health of the operatives. Factory legislation compels the ignorant employer to adopt them. If some means could be devised to make all the homes of the operatives as neat, elean, and wholesome as the factory, we should hear no more of the tendency of the factory to physieal degeneracy.

C.—If it could be shown that the faetory leads to intemperate habits, it would follow conclusively that it is productive of unthrift and poverty, the conditions sure to result from intemperance. It is true that a great deal of drunkenness exists in factory towns and among factory operatives; it is not true that the faetory is the creator of this. On the other hand, the investigations of Louis Reybaud, a member of the Institute of France, conducted in the name of the Academy of Moral and Politieal Science, relative to the condition of workingmen in various branehes of industry, prove conelusively that the factory operatives are far more temperate than those engaged under the domestic system. The industries of Franee afford the very best opportunities for comparative study in this respeet. In the U. S. drunkenness has never been much of an obstaele in the way of the sueeess of the factory. Factory towns support a large number of common laborers, and the intemperance of this class is usually attributed to the factory.

Unthrift and poverty do not belong to the factory system of industry to any such extent as they belonged to the system which it supplanted; indeed, the poverty existing at the birth of the factory system was one of the most potent influences which enabled it to grow. This is the historical view, not the sentimental one. There was a time when the drunkenness of factory operatives constituted a serious obstacle to the successful operation of factories in Great Britain and on the continent of Europe. Sunday was a day of debauch, and many, spinners especially, did not get into condition for work before Tuesday or Wednesday. It is the unanimous testimony of manufacturers in the leading factory towns of Great Britain that drunkenness is not now a serious obstacle to the running of their works, and in many places on the Continent the same testimony is given.

The U. S. affords the very best proof possible of the thriftiness of factory people, in this, that within a generation and a half the nationality of the cotton-factory operatives has changed from native-born and English to English and Irish, largely the latter, and now to French Canadian; with each change has come a class seeking an improvement of condition, and as the improvement has come the old have stepped up from the mills to higher occupations, shopkeeping, farming, etc., and the new have stepped in; and as their children become better educated than their parents, still others will crowd them out of the factories and receive the advantages which have advanced their predecessors in the way of progress.

D.—The charge that the factory fosters prostitution and swells the criminal lists is absolutely unfounded. This impression first grew from the condition of Manchester, England, where a large cellarage population, which has entirely disappeared, was attributed to the factory. It has been shown by the returns from the penitentiary of Manchester that the ranks of prostitution were not filled from the factory, 8 out of 50 coming from the factory, and 29 out of 50 from domestic service. An extensive examination of the criminal records of a large number of British factory towns discloses the fact that neither the ranks of prostitution nor the criminal lists are increased to such extent from the factory population of those towns as from other classes. This is equally true in the U. S. It should be borne in mind that regular employment is conducive to regular living, and that regular employment does not, as a rule, harmonize with a life of prostitution, intemperance, and crime. The virtue of the factory women of the U. S. and of Europe will compare favorably with that of any other class.

E.—In considering whether the factory system tends to an intellectual degeneracy of the operatives, as many urge, the writer can not use statistical data, but is obliged to rely to some extent upon the opinions of those whose positions entitle their statements to the fullest confidence. The impression that the factory system tends to intellectual degeneracy is entirely unfounded. Through the simplification of mechanical processes ignorant labor is congregated in factory centers, but it is not created or induced by the factory. The fact that the ignorant masses are enabled by the factory to engage in what it once took skilled labor to perform has given the widespread impression that factory labor has degraded the skilled, when in truth it has lifted the unskilled, and this is the inevitable result of the factory everywhere. It is a curious fact that after the factory system was established in Great Britain, and the poor, ignorant labor of the southern agricultural districts was lifted up to respectable and self-supporting employment and to comparative self-respect, the factory was held to be responsible for the ignorance which it found; and so the laws of Great Britain, and in later years of the U. S. too, have insisted upon the education of children as a prerequisite to factory employment. This may explain the superior intelligence of the children of factory towns in the United Kingdom as compared with those of agricultural localities. The half-timers of Great Britain and the factory children of the U. S. are laying a foundation, if proprietors will only recognize the power of moral forces in the conduct of industrial enterprises, which will ere long change the social complexion of factory towns. If the advantages afforded in factory towns will stimulate rural districts to emulate the work of providing for the proper amusement and instruction of children and young people, perhaps the constant depletion of such places may be checked and the inhabitants of crowded towns be attracted to the soil. The mental friction of the factory is not without its healthful influences. Instead of dwarfing the minds and the skill of the skillful, as is often alleged, the factory enlarges the minds and increases the power of the unskillful. Louis Reybaud, whose investigations have already been referred to, testifies that the abasement of intelligence, which is said to follow in proportion as tasks are subdivided, is a conjecture rather than a truth shown by experience, and is presumed, not proven. To prove abasement from factory employment it would be necessary to show, for example, that the hand-weaver, who throws the shuttle and gives motion to the loom, is of a class superior to the machine-weaver, who superintends such double movement. Employment of the muscles in several operations instead of one has nothing in it to elevate the faculties, and this is about all the opponents of the factory claim. "In their view," says Reybaud again, "the most imperfect machines, those which require the most effort, are the ones which sharpen the intellectual faculties to the greatest degree. We can easily see where this argument would carry us, if pushed to the end." There is no abasement; on the contrary, it is from the influences resulting from the factory system that one can discern the elevation of an increased proportion of working people from the position of unskilled to that of skilled laborers, and the opening of an adequate field of remunerative employment to women, two of the most important improvements in the condition of the working masses which could be desired; and these results are stimulated by the factory system.

The domestic system could not deal with machinery. While machinery in one sense means the factory system, it is really the type and representative of the civilization of this period so far as mechanics are concerned, because it embodies the concentrated, clearly wrought-out thought of the age. There is something educational in the very presence of machinery. A large proportion of the machines made use of under the factory system of industry were invented by workmen who have been desirous of finding out easier and readier means of performing their accustomed task. These things stimulate industry, which in turn stimulates frugality.

One of the positive results of the factory system has been to enable men to secure a livelihood in fewer hours than of old; this means intellectual advancement, for as the time required to earn a living grows shorter, civilization progresses. The most ignorant factory operative of to-day is more than the peer of the skilled workman of a few generations ago in all that goes to make up condition—environment. The fact that the lowest grade of operatives can now be employed in factories does not signify more ignorance, but a raising of the lowest to higher employments. This process will be repeated again and again, unless society is compelled to take up what is called a simpler system. This process is constantly narrowing the limits of the class which occupies the lowest step in the progress of society. This mission alone stamps the system as an active element in the moral elevation of the race. The factory system does not tend to intellectual degeneracy.

The main objections which are usually brought against the factory system have now been considered and it has been compared with the system it supplanted. Its evils come mostly under the heads enumerated, but they are evils which attend the development of the system; they are not its results. Before the system can be condemned as a system it must be shown that it is worse than that which it displaced. This can not be done. It is needless to apologize for the weaknesses of the present system, for they come mostly from ignorance, not from the system itself. Under enlightened men it becomes everywhere a great moral power, and a positive, active, and potential element in the processes of civilization. But, admitting every possible domestic evil which accompanies low social conditions—the neglect of young children, and consequent high rates of infant mortality, the physical degeneracy which follows mechanical employments when engaged in by married women—none of these can be attributed to the factory system as the creator of such evils. It can not be held responsible for their creation. They belong to the ignorance of the substratum of society, which the factory system is constantly lifting to another and higher plane, thereby lessening, instead of increasing, the misery of the world.

The misery caused by the change in systems has been softened, but in subtle ways. Transition stages are always harsh upon the generation that experiences them; the great point is that they should be productive of good results in the end. The mind recoils at the contemplation of the conditions which the vast increase of population would have imposed without the factory system.

The economic advantages of the factory system must be looked for in the increase of wages and production, and the decrease in the prices of goods produced. If the purchasing power of wages, so far at least as the products of the factory and the leading necessaries of life are concerned, has not been enhanced, the new system of industry has not yet wrought the good it is capable of working. Authoritative statistics from original and worthy sources, as well as from trustworthy writers and investigators, answer the question.

The true period from which to treat wages under the factory system in Great Britain is from 1830 to 1835. In the U. S. the period from 1815 to 1820 would be the true one, because there the condition of things related of the hand-loom weavers of Great Britain never existed. From 1833 the wages of factory operatives in Great Britain may be determined with sufficient accuracy to entitle the data to confidence. As already stated, at this period hand-loom weavers were in a deplorable condition; this was true of large towns and of villages; their wages were a miserable pittance, and they worked in confined and unhealthful dwellings. On the other hand, there was no large class of workmen in the kingdom receiving better wages than the operatives in cotton-factories.

The hours of labor in Great Britain have been reduced from twelve and one-half and thirteen per day to nine and one-half. An examination of British tables will convince one that for most divisions of labor in cotton-factories wages have very nearly doubled since the middle of the nineteenth century. The hours of labor have been reduced in the U. S., but not uniformly in all the States; where they were formerly thirteen or fourteen hours per day, they are now ten or eleven. It is true that where ten hours prevail both wages and production per person equal, if they do not exceed, the rates and quantities in States where longer hours constitute a day's work. Not only has the factory system reduced the hours of labor, but it has also increased the wages. For instance, in 1828 the average weekly wages of girls were $2.62; in 1880 they were $4.84. The consideration of most of the specific divisions of labor which can be compared will demonstrate the truth of this conclusion. In many cases wages have more than doubled, but from the data no general average can be deduced.

As to cost of production, a single illustration will suffice: the ratio of cost per pound, for labor, of common cotton cloth for the years 1828 and 1880 was as 6·77 to 3·31.

A study of industrial and social statistics relating to conditions in Great Britain and the U. S., as well as France, Germany, and Belgium, thoroughly corroborate all that has been said relative to the factory system. It can not be condemned until it is proven that it is worse than the system which preceded it.

See *Report on the Factory System of the United States*, by Carroll D. Wright (Washington, 1884); *Reports of the Massachusetts Bureau of Statistics of Labor*; *Reports of the Factory Inspectors of Massachusetts, Pennsylvania, and New Jersey*; *History of the Factory System*, by Whateley Cooke Taylor (London, 1886). CARROLL D. WRIGHT.

Factory Mutuals: See FIRE-INSURANCE.

Faculæ: See SUN.

Faculty [M. Eng. *facult*e: Germ. *Facultät*, from O. Fr. *faculte* > Fr. *faculté* < Lat. *facul'tas*, skill, deriv. of *fa'cul* = *fa'cilis*, easy, skillful, liter., makable, deriv. of *fa'cere*, make]: the collective designation of the instructing body of an institution of learning. It is a term of mediæval origin, and at first designated all the graduates, or those who had received power or authority (*facultas*) to impart instruction. There were said to be four faculties—those of philosophy, medicine, law, and divinity. Even now the whole body of graduates is occasionally so called, especially in the phrases "medical faculty" and "legal faculty," but more frequently the term is restricted to the body of officers of instruction and discipline in a college or university. See COLLEGE and UNIVERSITY.

Faculties of the Mind: See PSYCHOLOGY.

Fæ'ces [plu. of Lat. *fæx*, the lees of wine or the dross of metals]: the substances ejected by animals from the alimentary canal, consisting in general of (1) the surplus of the food, over and above what is needed for nutrition for the time being; (2) those elements of the food which are not available for nutrition; and (3) certain excrementitious and effete matters which the liver, the intestine, etc., have removed from the blood (stercorin, cholesterin, etc.). To these, in the Monotremata and all the vertebrates inferior to mammals (as well as in many invertebrates), the renal excretions are added. Fæcal matters are highly important as fertilizers, and this is especially true of guano and the excrement of birds generally, since it contains the urinary excretions combined, as has been seen, with those of the intestine, the whole in a very condensed form.

Fæc'ula, or **Fecula**; See STARCH.

Faed, fād, JOHN: artist; b. at Burley Mill, Kirkcudbrightshire, Scotland, in 1820. His father was an engineer and millwright, but the lad showed a taste for painting that made the homely surroundings tributary to it, and at the age of twelve finished a picture so well that his future career was determined. In 1841 he went to Edinburgh for study, and there, in 1850, exhibited pictures which attracted attention from their naturalness and met a ready sale. He painted *Shakspeare and his Friends*, *The Cotter's Saturday Night*, *The Soldier's Return*, *Tam o' Shanter*, *Haddon Hall of Old*, *John Anderson, my Jo*, *Parting of Gabriel and Evangeline*, and other pieces of kindred character, clothing historical fact with sentiment. In 1864 he removed to London, where he lived until 1884, when he returned to Kirkcudbrightshire.

Faed, THOMAS: genre-painter; b. at Burley Mill, Scotland, 1826. Pupil of his brother, John Faed; Royal Academician, 1864. His work is very weak in technique, but is popular in Great Britain. *Shakespeare and his Contemporaries* is in the Corcoran Gallery, Washington. D. Aug. 17, 1900. W. A. C.

Faenza, fa̤a-en'za̤a: city of Italy; province of Emilia; 19 miles S. W. of Ravenna (see map of Italy, ref. 4–D). It has manufactures of linen, silk, paper, and glazed earthenware, which indeed received its name (*faïence*) from this city. The city has a cathedral and many palaces and remarkable old buildings. Salt is manufactured in the neighborhood. Pop. 36,100.

Faeroe, fā'rō, **Islands** (Dan. *Färöerne*): a group of islands, of which only seventeen are inhabited, belonging to Denmark, and situated in the North Atlantic nearly midway between the Shetlands and Iceland, between lat. 61° 20′ and 62° 20′ N., and between lon. 6° and 8° W. Their entire area is 514 sq. miles. The principal island is Stromö, capital Thorshavn. All these island are basaltic formations, rising conically to a height of 3,000 feet, with steep and lofty coasts, abruptly broken by deep inlets, which often afford the safest and most convenient anchorage, but which sometimes cause whirlpools or form currents, thereby making navigation very dangerous. The trap-rock is covered with a thin layer of vegetable soil, which yields a fine pasturage. There are no trees on account of the furious gales which always prevail here; peat and Miocene coal, of which there is a seam of good quality on Suderöe, are used as fuel. Of the common cereals and vegetables, only barley, turnips, and potatoes can be raised, on account of the high northern latitude; yet the oceanic influences modify the climate so greatly that snow rarely lies long on the ground, and cattle and sheep graze the greater part of the year in the open air. The waters abound with fish, and the feathers and eggs of the myriads of fowls which swarm around these coasts are sources of considerable wealth. The inhabitants are of Norwegian origin. In the ninth century the islands were discovered by the Norwegians and peopled by Norwegian settlements, but during the long connection between Denmark and Norway the islands passed into possession of the Danes. Pop. (1890) 12,954.

Fagging [deriv. of *fag*, a drudge, probably connected with O. Eng. *fœge*, doomed, timid: Germ. *feige*, cowardly]: a custom which is part of the public-school system of England. This custom differs in detail in the several schools, but rests in all on the same principle. This principle is that the discipline of the school should be left, as far as possible, to the boys themselves, the responsibility for order being thrown on the highest form, known as the sixth form, called also prefects (as at Winchester) or præposters (as at Rugby). Those who are thus responsible for discipline have also the right of "fagging" the boys in the lower forms, those in the forms immediately under the sixth being exempted. Dr. Arnold defines fagging as "the power given by the supreme authorities of the school to the sixth form, to be exercised by them over the lower boys, for the sake of securing a regular government among the boys themselves, and avoiding the evils of anarchy; in other words, of the lawless tyranny of brute force." (*Quarterly Journal of Education*, vol. ix.) The origin of this custom of fagging can not be ascertained with any certainty, but so far as there are any authentic records, it would seem always to have existed in the old schools. Thus it is clear, from Christopher Johnson's poem *De Collegiis* and the *Consuetudinarium Vetus Scholæ Etoniensis*, that it was in active operation at Winchester and Eton in the sixteenth century. It is probable, however, that the custom arose as soon as the schools received any large number of boys as boarders. It is indeed obvious that where large numbers of boys of ages ranging from ten and eleven up to nineteen are thrown together away from their own homes, they must be placed either under the constant surveillance of masters or under some distinct and recognized form of self-government. The latter alternative has always prevailed in the English public schools, and is in fact the only one which is in accord with the national character. There is abundant proof, moreover, that the custom of fagging as a part of the system does not stand merely on tradition, but is accepted as beneficial in the fact that it has been deliberately introduced in the schools which have been founded in the nineteenth century. The number of the great public schools had remained stationary for 300 years, since Queen Elizabeth's reign, during which Harrow, Rugby, and other schools not so well known were founded. A remarkable revival followed the accession to the throne of Queen Victoria, and a number of public schools have been founded, of which the best known are Marlborough, Haileybury, Wellington College, and Cheltenham. Fagging has been introduced in all but Cheltenham. At Cheltenham, where the school is in a large town, and is chiefly composed of day-scholars, or boys living at their own homes, though there is no legal system of "fagging" recognized by the school authorities, the practice exists, but without the usual safeguards against abuse. In all the schools the power of fagging carries with it certain duties. Besides that of keeping order generally, the sixth-form boy is the recognized adviser and protector of those fags with whom he comes in immediate contact. In any case of bullying or bad conduct the appeal of the aggrieved boy is to the sixth-form boy of his room or passage, or to the head of his house, and not to his tutor or house or form master. And the sixth-form boy is bound to accept the responsibility of acting himself, and would completely lose caste were he to refer any but flagrant cases of ill-conduct to the master.

Until well into the nineteenth century "fagging" included a number of menial functions, such as cleaning boots and candlesticks, and the power of the sixth form was practically unlimited as to hours. A boy might be fagged, for instance, during a whole afternoon at cricket, day after day. All this is changed. At Eton and one or two other schools there is no cricket-fagging, and in those where it exists it is very light. Thus at Haileybury the whole of the fags are taken in regular order for one hour, so that each fag's turn comes only once in three weeks, and even then he is let off if he makes a good catch or otherwise distinguishes himself. A similar custom prevails at Marlborough, where, however, besides the sixth form, the eleven have the power of fagging at cricket—a solitary example (it is believed) where this power is not dependent on proficiency in study as evidenced by position in the school. Football-fagging is also very light at all the schools except Rugby, only some half-dozen fags being told off to keep the ball in bounds. At Rugby every fag is obliged to play "little side," lasting two hours at most, unless he holds a medical certificate of inability to play. He is also obliged to run (in the paper chases) unless holding such a certificate. Apart from games, general fagging is practically confined to running errands, a sixth-form boy having power to call any fag, at any time, for this purpose. House-fagging, in like manner, consists of little beyond small services of this kind—carrying up the trays on which their master's breakfast and tea things are set, and perhaps toasting a round of bread or a rasher of bacon. "Study-fagging" still exists at Rugby, where each sixth-form boy has two fags specially attached to him, who sweep out his study and put it in order in alternate weeks. At the school-house also "night-fagging" is still in force. Every fag has his choice between study-fagging and night-fagging. The rota of night-fags is kept by the head fag, who tells off four for each week in the term. Their duties are to be ready in the passages between 8.30 and 9.30 to answer the call of any of the sixth form.

At Eton the fifth form have the power of fagging, but (as above stated) it is usually confined exclusively to the sixth form. The numbers of the sixth are not strictly limited, but seldom exceed thirty-five or forty. Harrow has the largest sixth form of any school, divided into the "upper," "lower," and "modern side," and numbering eighty, all of whom have the power of fagging, but only the fifteen highest, or "monitors," have the power of enforcing discipline with the cane, if necessary. At Harrow only the fifth-form boys are exempt from fagging.

The most distinguished masters of public schools, from Dr. Arnold downward, have been singularly unanimous in their approval of the modified system of fagging which now exists. The public opinion both of old public-school men and of the boys themselves is also strongly in favor of it as the best means of maintaining the due subordination of ranks, of keeping down "cheek," and preventing bullying. There is every likelihood, therefore, that it will continue in its present form. See also Arnold's *Life* by Stanley (1st ed. vol. i., p. 105), and *Report of Public School Commissioners* (1864), and *Appendix of Evidence of Bishop of Exeter, Drs. Butler, Balston, and others*; and specially section of *Report on Monitorial System*, p. 42, *et seq.* THOMAS HUGHES.

Fagius, faa'gĕe-oos, PAUL BÜCHEIN: German Protestant theologian; b. at Rheizabern, in the Palatinate, 1504; pastor at Isny in 1537, and Professor of Hebrew at Strassburg in 1544. Was in England in 1549, and was appointed to the chair of Theology at Cambridge University, but died Nov. 12, 1549. His body was exhumed and burned by order of Queen Mary, Feb. 6, 1557.

Fagotto, faă-got'tō: the Italian name for the bassoon, evidently from its resemblance to a faggot or bundle of sticks. In German the word is *Fagott*.

Fagrskinna, faăg'r-skin'-naă [Icel., Fair-skin]: a famous parchment manuscript containing a compendious account of the Norwegian kings from Hálfdan Svarti to Sverri; compiled about the beginning of the thirteenth century in Norway from Icelandic sources. The manuscript was called Fagrskinna by Torfæus on account of its handsome binding. It belonged to the Copenhagen University Library, and was destroyed in the fire of 1728. At the same time another parchment of the same compendium perished, with the exception of a small fragment. Paper copies of both manuscripts have been preserved, however, and from these the work was edited by Munch and Unger: *Fagrskinna. Kortfattet Norsk Konge-Saga fra Slutningen af det XII. eller Begyndelse af det XIII. Aarhundrede* (Christiania, 1847). See also G. Vigfusson, *Sturlunga Saga, Prolegomena*, pp. 87–88 (Oxford, 1878). G. L. K.

Fagus: See BEECH.

Fahlcrantz, faal'kraănts, CHRISTIAN ERIK: poet and theologian; b. in Dalarna, Sweden, Aug. 30, 1790; Professor of Dogmatic Theology at Upsala 1835; Bishop of Vesterås 1849. His most important literary works are *Noachs Ark* (Stockholm, 1825–26), rated as the best long humorous poem in Swedish, and an epic on the Scandinavian apostle Ansgarius (*Ansgarius. Bilder ur Nordapostelns Lif i fjorton Sånger*, Upsala, 1835–46). He also published various essays, sermons, and occasional and controversial writings. His *Rom förr och nu* (Vesterås, 1858–61) caused much discussion. D. at Vesterås, Aug. 6, 1866. His collected works (*C. E. Fahlcrantz Samlade Skrifter*) were published at Örebro in seven vols. (1863–65). G. L. K.

Fahlun: See FALUN.

Fahrenheit, faă'ren-hīt, GABRIEL DANIEL, F. R. S.: physicist; b. at Dantzic, Prussia, May 14, 1686; became a constructor of scientific instruments; resided in France, England, and afterward in Holland, and was everywhere recognized as one of the leading physicists of his time. In 1720 he first introduced the use of mercury in thermometers. He invented the Fahrenheit scale (see THERMOMETER); also an improved areometer and other valued instruments. He was the author of several learned papers, chiefly regarding heat and specific gravities. D. at Amsterdam, Sept. 16, 1736.

Faidherbe, fā'dārb', LOUIS LÉON CÉSAR: general; b. at Lille, France, June 3, 1818, and began his career in the colonies, principally in Algeria, where he served with distinction. He made himself favorably known while governor of Senegal by several valuable scientific papers which were published in the *Annuaire du Sénégal* (1859, 1860, and 1861) and in the *Bulletin de la Société de Géographie.* He also wrote *Chapitre de Géographie sur le Nord-Ouest de l'Afrique* (St. Louis, 1864), and *Collection complète des inscriptions Numidiques* (Paris, 1870). He published from

1860 the *Bulletin du Sénégal* (St. Louis), and rendered the French government in Africa service by his exact knowledge of the country and its population, and by his talent of organization. On Dec. 3, 1870, he received the supreme command of the armée du Nord, organized in and around Lille, and fought the indecisive battles of the Halluc (Dec. 23, 1870) and Bapaume (Jan. 3, 1871), and was defeated at St.-Quentin (Jan. 19, 1871). Acknowledged as a very able commander and organizer in war, Faidherbe after the war joined the party of Gambetta, and was elected from Lille. But when the government of Thiers triumphed, and the influence of Gambetta decreased, Faidherbe retired from public life. Author of *Campagne de l'armée du Nord* (Paris, 1871). D. Sept. 28, 1889. Revised by C. H. THURBER.

Faïence, făă'i-ăăñs [Fr., from Ital. *Faenza*, the original place of its manufacture]: glazed pottery, especially that which is painted in colors.

Faillon, făă'yōñ', MICHEL ÉTIENNE: missionary priest; b. at Tarascon, France, in 1799; became a Sulpician in Paris, and in 1854 went to Canada as a visitor to the Sulpician houses of that country. He published numerous valuable biographies of distinguished French Canadian religionists, and undertook an extended history of the French in Canada, of which 3 vols. (1865–66) were completed. D. in Paris, Oct. 25, 1870.

Failly, făă'yee', CHARLES ACHILLE, de: general; b. at Rozoy-sur-Serre, Aisne, France, Jan. 21, 1810. After 1828 served partly in France, partly in Algeria; commanded a brigade in the Crimean war; in the war against Austria, in 1859, commanded a division of the Fourth Army-corps, and on the day of the battle of Solferino received the grand cross of the Legion of Honor. In 1867 he commanded the expedition whose task was to protect the pope against the attacks of Garibaldi, and his name attained a sad celebrity from the battle of Mentana, in which Garibaldi's irregular host were slaughtered. In 1870 he commanded the Fifth Army-corps, and was deprived of his command on the day before the battle of Sedan for failing to go to the support of MacMahon at Wörth; wrote in his vindication *Opérations et marches du cinquième corps* (1871). D. Nov. 15, 1892.

Fainéants, fā'nā'ăăñ' [Fr. plur. of *fainéant*, idle, do nothing; *fait*, does + *néant*, nothing]: a name applied to several Frankish sovereigns, chiefly of the Merovingian dynasty. The title is indicative of their idle and worthless reigns, which, indeed, were merely nominal. Thierry III. of Austrasia and Burgundy, Clovis III., Childebert III., Dagobert III., Chilperic II., Thierry IV., and Childeric III., all Merovingian Kings of France, were *rois fainéants*, as was also Louis V., the last of the Carlovingians. The same appellation is often applied to worthless monarchs of later times and other countries.

Fainting, or **Syncope** [*fainting* is a deriv. of Mid. Eng. *feint*, from O. Fr. *feint*, perf. partic. of *feindre*, feign < Lat. *fin'gere*, shape, contrive, feign]: a more or less complete and sudden loss of sensation and of the power of motion, unaccompanied by convulsions, but usually attended by feebleness of the circulation and respiration. Fainting is attended by anæmia of the brain, its proximate cause; more remotely it may be caused by loss of blood, by profound emotional disturbance, or by heart-disease. Closely akin to it, but more permanent and dangerous, are the collapse which occurs in cholera (caused by loss of the fluid constituents of the blood) and the shock which follows severe injuries. Fainting is to be treated by placing the patient on his back in a horizontal position, or with the head and chest slightly depressed below the level of the rest of the body; by admission of fresh air to the patient; and, in prolonged cases, by applying diffusive stimulants to the nostrils and restoring to artificial respiration. Fainting is seldom mortal, unless in case of severe disease.

Faioum: See FAYUM.

Fair [Mid. Eng. *feire*, from O. Fr. *feire* > Fr. *foire* < Lat. *fe'riæ*, holidays. *Feast*, from Lat. *festus*, festal, is akin. The meaning has changed from holidays to fair, because mediæval fairs were held on saints' days]: originally a stated temporary market containing many kinds of goods and wares. When population was sparse, and the means of traveling and transportation were extremely limited, it was found most convenient to expose merchandise for sale at the largest gatherings of the people. Hence European fairs were early identified with religious festivals, and were often designated by the name of the saint in whose honor each festival was held. However, as the difficulties and dangers of intercommunication diminished, and the number of cities and villages increased, factories, shops, and warehouses became more accessible, and the inhabitants generally found it more convenient, as well as more profitable, to buy goods as they needed them, from time to time, than to purchase a year's supply in advance. Thus fairs for the sale of goods constantly decreased in number and importance with the growth and improvement of each country, until not more than two or three of any note were held in all Europe. The most famous of these—and, it is said, the largest in the world—is held annually at Nijni-Novgorod in Russia, situated at the confluence of the rivers Volga and Oka, about 265 miles E. of Moscow. It begins on July 15 and continues into September. The sales at this fair are reported to have reached in one year the enormous sum of 150,000,000 roubles (about $112,000,000). The average annual value of goods sold is not far from $100,000,000. Among other large annual fairs held in Europe are those of Leipzig, Germany, and Beaucaire, France. In Arabia, Hindustan, and other Eastern countries such fairs are still held, and will continue to be held until the general introduction of railways and other modern improvements. See COMMERCE and MARKET.

In the U. S. temporary markets containing the effects of itinerant merchants are entirely unknown, although the term *fair* is often applied to such collections of fancy articles as are generally sold by ladies for the benefit of religious and charitable associations. This term has, however, a far higher meaning, and now more frequently designates a collection of superior products which are exposed, not for sale, but mainly for public inspection, and for careful examination by experts as to their respective qualities. They may be divided roughly into agricultural fairs, local expositions, and international expositions or world's fairs. See EXPOSITION.

Attempts were made at an early day in the U. S. to encourage art and invention by offering prizes for superior specimens of a few kinds of goods, but no permanent system for improvement was established until the year 1810. Elkanah Watson, a merchant of Albany, N. Y., whose original plans regarding inland navigation, uniform currency, and general education entitle him to a prominent place among American philanthropists, was the real author of the present system of fairs and cattle-shows sustained and directed by agricultural societies. He retired from active business, removed to his farm near Pittsfield, Mass., where he conceived the idea of interesting the farmers of Berkshire County in holding an exhibition of improved breeds of cattle and superior products of the soil, for the purpose of proving what might be accomplished by proper culture; and to compensate and reward exhibitors for the care and labor bestowed on their specimens, prizes were to be awarded for the best. The first fair was a success, and for the purpose of enlarging the next he appealed to the citizens of Boston for pecuniary aid, but failed to get a single favorable response. Ex-President John Adams, in his reply, made it quite apparent that the leading men of that day did not appreciate the importance of this new step for encouraging the useful arts. This was pithily expressed in a single sentence: "You will get no aid from Boston; commerce, literature, theology, medicine, the university, and universal politics are against you." Watson was not thwarted by this rebuff; he redoubled his exertions at home, and for several years annual fairs were held. In 1815 he returned to Albany, and immediately proceeded to organize an agricultural society and to establish fairs and cattle-shows in the neighboring counties. In 1819 the Legislature of the State of New York passed an act appropriating $10,000 annually, for six years, for the promotion of agriculture and family manufactures, which was to be divided among the agricultural societies of the several counties in proportion to their population, provided a like sum was raised in each by voluntary subscription. In 1832 a State agricultural society was incorporated, and in 1841 a law was passed similar to that of 1819, appropriating the sum of $8,000. Under the present system each county agricultural society is required to report annually to the State society, which embraces the essential parts of the whole in its report to the Legislature. This plan of organizing State and county agricultural societies, with power to hold fairs, has since been adopted in nearly all the States of the Union.

Among local expositions or fairs of importance may be mentioned those of the American Institute of the city of New York, the Franklin Institute of Philadelphia, the industrial exhibitions of Chicago, Cincinnati, St. Louis, New Orleans, and San Francisco; besides numerous other cities of North America and Europe. These exhibitions embrace not only agricultural products, but superior specimens of the fine, ornamental, and useful arts, including working models of recent inventions, machinery in motion, improved chemical and mechanical processes, with the material resulting therefrom, and practical illustrations of the best methods of generating and utilizing force. Revised by A. T. HADLEY.

Fairbairn, ANDREW MARTIN, D. D: clergyman and author; b. near Edinburgh, Nov. 4, 1838; graduated at Edinburgh University 1860; studied theology at Evangelical Union Hall, Glasgow, 1856–61. He was in Germany, as a pupil of Dorner (1866 and 1867). In 1861 he became pastor of an Independent church in Bathgate, Scotland. He was principal of Airedale College in Bradford, England, from 1877 until 1886, when he became the first principal of Mansfield College, Oxford. Both these institutions are Congregational schools of theology. He was Muir lecturer in the University of Edinburgh 1878–83. Besides important contributions to the *Contemporary Review*, he has published *Studies in the Philosophy of Religion and of History* (1876); *Studies in the Life of Christ* (1880); *The City of God* (1882); *Religion in History and in Life of To-day* (1884). He also edited the *Hibbert Lectures* for 1888, by Dr. Hatch (1890); and is author of *The Place of Christ in Theology* (New York, 1893). In 1892 he delivered the lectures on the Lyman Beecher foundation at the Yale Divinity School. GEORGE P. FISHER.

Fairbairn, PATRICK, D. D.: theologian; b. at Greenlaw, Berwickshire, Scotland, Jan. 28, 1805; graduated at the University of Edinburgh 1826; was settled in 1830 in one of the Orkney islands, at Bridgeton, a suburb of Glasgow, in 1837, and at Salton, near his birthplace, in 1840. He joined the Free Church at the Disruption, 1843, and formed a new congregation at Salton. In 1853 he became Professor of Theology at the Free Church College in Aberdeen; was in 1856 made principal and Professor of Systematic Theology and New Testament Exegesis in the Free Church Theological College at Glasgow. His principal works are *The Typology of Scripture* (Edinburgh, 2 vols., 1845–47; 5th ed. 1870); *Commentary on Ezekiel* (1851; 2d ed. 1855); *Prophecy, its Nature, Functions, and Interpretation* (1856); *Hermeneutical Manual* (1858); *Revelation of Law in Scripture* (1868); and a commentary on *The Pastoral Epistles of Paul* (1873); *Pastoral Theology* (posthumous, 1875). He visited the U. S. in 1871. D. at Glasgow, Aug. 6, 1874. Revised by S. M. JACKSON.

Fairbairn, ROBERT BRINCKERHOFF, D. D., LL. D.: clergyman of the Protestant Episcopal Church; b. in New York city, May 27, 1818; educated at the Mechanics' School in Chambers Street, New York, at Trinity College, Hartford (B. A. 1840), and also at the General Theological Seminary, New York. Immediately after his ordination as deacon July 2, 1843, he became the rector of Christ Church, Troy, N. Y. From 1853 to 1862 he was the principal of the Catskill Academy, as well as rector of Calvary Church, Cairo, N. Y. In 1862 he was appointed the Professor of Mathematics and Natural Philosophy in St. Stephen's College, Annandale, N. Y., of which he became warden in 1863, and also Professor of Moral Philosophy. Later he was until 1891 president of the college, which, through the liberality of the Rev. C. F. Hoffman, D. D., of New York city, has been largely endowed and supplied with noble buildings. He wrote *On the Doctrine of Morality in its Relation to the Grace of Redemption* (1887), etc. D. in Brooklyn, N. Y., Jan. 27, 1899.

Fairbairn, Sir WILLIAM, Bart., F. R. S., LL. D.: civil engineer; b. at Kelso, Scotland, Feb. 19, 1789; began business at Manchester in 1817, and introduced several important mechanical improvements, among which were the substitution of iron for wood in the shafting of cotton-mills and the use of lighter shafting where metal was already in use. His attention was next directed to the use of iron for ships, and he was the first in England to construct an iron ship. More than 100 iron ships were constructed by his firm, varying in size from the smallest to the war-vessel of 2,600 tons. By invitation of the British Association (1834–35), in connection with Mr. Hodgkinson, he investigated the causes of certain supposed defects in iron produced by hot-blast furnaces, and submitted a valuable report upon the subject. His experiments to test the strength of iron and the resistance of tubes or cylinders led to valuable practical results. Mr. Fairbairn co-operated with Robert Stephenson in designing and constructing the great tubular bridge across the Menai Strait. Sir William was one of the founders of the British Association for the Advancement of Science, and the author of many valuable professional books and papers, among which may be mentioned *Mills and Mill-work*; *Iron, its History and Manufacture*; *Application of Iron to Building Purposes*; *Iron Ship-building*; *Useful Information for Engineers*, 1st, 2d, and 3d series; *An Experimental Inquiry into the Strength, Elasticity, Ductility, and Other Properties of Steel* (1869), which was several times reprinted. President of the British Association, corresponding member of the National Institute of France, member of many other learned societies, and chevalier of the Legion of Honor. Created a baronet in 1869. D. Aug. 18, 1874.

Fairbury: town and railway junction; Livingston co., Ill. (for location of county, see map of Illinois, ref. 4–F); 10 miles S. E. of Pontiac. It has grain-elevators, mills, shops, factories, etc., and is situated in a thickly settled and fertile region, abounding in coal, limestone, fire-clay, sandstone, and a micaceous quartz which affords a fine fireproof building material. Clays of nearly all colors abound. Pop. (1880) 2,140; (1890) 2,324; (1900) 2,187.

Fairbury: city and railway center (founded in 1869); capital of Jefferson co., Neb. (for location of county, see map of Nebraska, ref. 11–G); on Little Blue River; 55 miles S. S. W. of Lincoln. It has fine churches, good schools, abundant water-power, a flouring-mill, a foundry, and one of the largest nurseries in the U. S.; also electric lights, water-works, and a telephone system. Pop. (1880) 1,251; (1890) 2,630; (1900) 3,140. EDITOR OF "GAZETTE."

Fairchild, CHARLES STEBBINS, A. B., L. B., LL. D.: lawyer; b. at Cazenovia, N. Y., Apr. 30, 1842; graduated at Harvard College 1863, at the Harvard Law School 1865, and was admitted to the bar. He was deputy attorney-general of New York 1874–75, attorney-general of New York 1876–77, assistant Secretary of the Treasury 1885–87, and Secretary of the Treasury 1887–89. He received the degree of LL. D. from Columbian University.

Fairchild, JAMES HARRIS, D. D.: Congregationalist; former president of Oberlin College; b. at Stockbridge, Mass., Nov. 25, 1817; graduated at Oberlin College, 1838; a professor there, in different chairs, since 1839; elected president in 1866, which office he resigned, 1889. He has published *Moral Philosophy* (1869); *Oberlin, the Colony and the College*, etc. (1883); *The Elements of Theology, Natural and Revealed* (1892); and has edited the *Memoirs of Finney* (1886) and Finney's *Systematic Theology* (1878). Revised by GEORGE P. FISHER.

Fairchild, LUCIUS, LL. D.: U. S. military officer; b. at Kent, Portage co., O., Dec. 27, 1831. In 1846 he removed with his father to Wisconsin, and at the age of eighteen to California, but returned to Wisconsin in 1855, and in 1860 was admitted to the bar. On the outbreak of the civil war in 1861 he became captain of the First Wisconsin Regiment; subsequently was commissioned a captain in the Sixteenth Regiment of the regular army, also major, lieutenant-colonel, and colonel of volunteers; became a brigadier-general of volunteers, Oct. 19, 1863; resigned Nov. 2, 1863. He was Secretary of State of Wisconsin 1864–65; and Governor 1866–72; U. S. consul at Liverpool, England, 1872–78; consul-general at Paris, 1878–80; and U. S. minister to Spain 1880–81; in 1886 elected commander-in-chief of the Grand Army of the Republic; also served as regent of the State University and of the State Normal schools, and as president of the Cherokee commission. D. at Madison, Wis., May 23, 1896.

Fairfax, DONALD MCNEIL: rear-admiral U. S. navy: b. in Virginia, Aug. 10, 1823; entered the navy as a midshipman Aug. 12, 1837. In 1861, when executive officer of San Jacinto, he personally supervised the arrest of Messrs. Mason and Slidell on board the English mail-steamer Trent. Commanded steamer Cayuga in 1862 on the Mississippi river; in command of monitor Nantucket participated in the first attack upon Fort Sumter, Apr. 7, 1863. In command of monitor Montauk took part in all the fights with the forts and defenses of Charleston harbor which occurred during July and Aug., 1863. He became rear-admiral July 11, 1880; retired Sept. 30, 1880, at his own request, after forty years' consecutive service. D. at Hagerstown, Md., Jan. 10, 1894.

Fairfax, EDWARD: poet; son of Sir Thomas Fairfax; b. at Denton, Yorkshire, England, about 1580; translated Torquato Tasso's *Jerusalem Delivered* into English, verse for verse, and this work is still of standard excellence. *A History of Edward the Black Prince*, in verse, and a *Discourse of Witchcraft*, etc., are also his works. The American edition of his great translation (1855) gives the text of Charles Knight's edition from the old folio edition of 1600. D. at Fenston, near Otley, in Jan., 1635.

Fairfax, John Contee, M. D.: eleventh Lord Fairfax; a resident of Bladensburg, Prince George co., Md.; b. Sept. 13, 1830; a younger son of Hon. Albert Fairfax; succeeded to the title in 1869 on the death of his brother, Charles Snowden Fairfax, the tenth Lord Fairfax. Dr. Fairfax in early life practiced medicine at Woodburne, Md., and in 1857 married a daughter of Col. Edward Kirby, U. S. army. D. Northhampton, Md., Sept. 28, 1900. His cousin, Mr. Raymond Fairfax, is the heir-presumptive to the title. The Fairfaxes are of the Scottish peerage, and never had a seat in the British House of Lords. The first of the title was Ferdinando, a nephew of the poet, Edward Fairfax; made a peer in 1627, d. in 1648. He was the author of some extant writings.

Fairfax, Thomas, Lord: general; b. at Denton, Yorkshire, England, Jan. 17, 1611; was son of Ferdinando, Lord Fairfax, and Mary, daughter of Edmund Sheffield, Lord Mulgrave; served in Holland as a volunteer under Horace, Lord Vere, whose daughter he afterward married; at the outbreak of civil war in 1642 received from Parliament a commission as general of cavalry, his father being commander-in-chief of the northern forces; defeated the royalists under Col. Bellasis, Apr., 1644, and July 2 of that year was especially distinguished by bravery and activity at the king's defeat at Marston Moor, where he commanded the right wing; in Jan., 1645, became commander-in-chief of the parliamentary or "new model" army, with Oliver Cromwell as lieutenant-general; gained the battle of Naseby, June 14, 1645, and on June 18 took Leicester; on July 22 took Bridgewater, on Sept. 10 Bristol; in June, 1646, captured Oxford, and Charles I fled to Scotland. Fairfax was then commissioned by Parliament to carry £200,000 to the Scotch army, who agreed to deliver the king to him for that sum. He met the king near Nottingham Feb. 11, 1647. Soon after this he yielded to the genius of Cromwell, and when, in Mar., 1648, he succeeded to his father's titles, continued to fight for him. Appointed one of the high court of justice in 1649, he attended but a single session of the court. In the spring of 1649 he was made commander of all the forces in England and Ireland, but refused to fight the Scots, and resigned his commission in June, 1650. In Sept., 1654, he was a member of Cromwell's first Parliament, and in Dec., 1659, took part with Monk in the defeat of Lambert; Jan. 1, 1660, was a member of the council of state, and in May chairman of the committee delegated by the House of Commons to prevent the return of Charles II. Fairfax, who was a warm friend to learning, wrote *Short Memorials of Thomas, Lord Fairfax*, besides theological, poetical, and other compositions. D. of a fever at Nun Appleton, on his estates, Nov. 12, 1671.

Fairfax, Thomas, Lord: b. in England, 1691; settled in the county of Frederick in Virginia, where he had large estates. He made the acquaintance of George Washington in 1748, and the friendship between them was unbroken by the American Revolution, although Fairfax was ever a frank and avowed loyalist. Such were his qualities, indeed, that his property was always equally respected by the Americans and the English. D. at Greenway Court, Frederick co., Va., Dec. 12, 1781, and his immense domain of 5,282,000 acres was then confiscated.

Fairfield: town and port of entry; Fairfield co., Conn. (for location of county, see map of Connecticut, ref. 12–E); situated near Long Island Sound, and on railway; 52 miles N. E. of New York. It was formerly one of the capitals of the county; in 1637 it was the scene of the last conflict with the Pequot Indians, and in 1779 it was burned by the British troops under Tryon. Fairfield has some manufactures and considerable traffic, and is a place of summer resort, one of the most beautiful in the State. Fairfield township includes also the villages of Southport and Greenfield Hill, both beautiful places. Southport is the chief business center. Lat. 41° 8′ 30″ N., lon. 73° 12′ 44″ W. Pop. of township (1880) 3,748; (1890) 3,868; (1900) 4,489.

Fairfield: town and railway junction; capital of Wayne co., Ill. (for location of county, see map of Illinois, ref. 9–F); 108 miles E. by S. of St. Louis, Mo. It is the seat of Hayward Collegiate Institute, and has an extensive woolen factory, and large flouring and saw mills. Pop. (1880) 1,391; (1890) 1,881; (1900) 2,338.

Fairfield: city; capital of Jefferson co., Ia. (for location, see map of Iowa, ref. 7–J); situated on a fertile, high-rolling, and well-wooded prairie; on the Burlington Route, and the Chi., R. I. and Pacific R. R.; 50 miles W. of Burlington. It is the seat of Parsons College (Presbyterian), and has a business college, two schools, a large library, a canning factory, and manufactures of wagons, furniture, farming implements, and tile. Pop. (1880) 3,086; (1890) 3,391; (1900) 4,689.
Editor of "Journal."

Fairfield: town; Somerset co., Me. (for location of county, see map of Maine, ref. 6–C); on railway and on the W. bank of the Kennebec river; 21 miles N. of Augusta; has excellent water-power. The township contains an extensive canning-factory, furniture-factories, woodshops, saw-mills, tannery, machine-shop, and foundry; also a large framing-mill where buildings are manufactured entire. Pop. of township (1880) 3,044; (1890) 3,510; (1900) 3,878.
Editor of "Journal."

Fair Haven: post-village; New Haven co., Conn.; on the Quinnipiack river; constitutes a ward of the city of New Haven (*q. v.*). It has some important manufactures, but its chief industry is oyster-culture, and the manufacture of lime from the oyster-shells.

Fair Haven: town; Bristol co., Mass. (for location, see map of Massachusetts, ref. 5–I); on branch of Old Colony Div. of N. Y., N. H. and Hartford R. R., and on the east side of Acushnet river; opposite New Bedford; 60 miles S. of Boston. It has four churches, excellent schools, a large and well-endowed public library, a fine town-hall, and manufactures of tacks, nails, castings, etc., besides some fishing interests. The harbor is good and will admit vessels drawing 18 feet. The village is connected with New Bedford by two bridges. On Sept. 7, 1788, it was attacked by the British, who were repulsed by the militia under Maj. Israel Fearing. Pop. of township (1880) 2,875; (1890) 2,919; (1900) 3,567.
Editor of "Star."

Fairhaven: town (founded Oct. 27, 1779): Rutland co., Vt. (for location of county, see map of Vermont, ref. 7–B); on railway; 16 miles E. of Rutland and 9 miles N. E. of Whitehall, N. Y. It has seven churches, an incorporated school, great water-power, and extensive manufactures of milled and roofing slate, the materials for which are quarried here. Pop. of township (1880) 2,211; (1890) 2,791; (1900) 2,999.
Editor of "Era."

Fairhaven: city (founded May 10, 1889); Whatcom co., Wash. (for location of county, see map of Washington, ref. 1–D); situated on Bellingham Bay, in the Puget Sound basin; 7 miles from the Gulf of Georgia and 16 miles from the Strait of Juan de Fuca, which leads into the Pacific. It is 17 miles S. of British Columbia and 80 miles N. of Seattle; comprises 6 sq. miles, adjoining New Whatcom, and has 3 miles of water-front available for ocean-going vessels. The city is well provided with churches and schools. The principal resources are lumber, coal, and iron; there are also fertile suburban farms and orchards. The railway facilities comprise the Canadian Pacific and the Great Northern. Pop. (1890) 4,076; (1900) 4,228.
Editor of "Herald."

Fair Havens (translation of Gr. Καλοὶ Λιμένες): a harbor on the south side of the island of Crete, mentioned by Luke (Acts xxvii. 8), and by no other ancient writer. St. Paul sailed out of this harbor shortly after the middle of October, and was shipwrecked about Nov. 1, 60 A.D. It appears to have been the port of Lasæa, the ruins of which were discovered in 1856 by the yachting-party of Hugh Tennent, Esq. See James Smith, *Voyage and Shipwreck of St. Paul* (1848; 3d ed. 1866).

Fair Head, or **Benmore Head**: a lofty promontory of the coast of county Antrim, Ulster, Ireland, opposite Rathlin Isle. It consists of Carboniferous strata overlaid by greenstone columns, and rises 636 feet perpendicularly above the sea. Lat. 55° 13′ N., lon. 6° 8′ W.

Fair'holt, Frederick William: English artist and writer; b. in London, 1814; published *Costume in England, a History of Dress to the Close of the Eighteenth Century* (1846); *The Home of Shakespeare Illustrated and Described* (1847); *Remarkable and Scientific Characters* (1849); *Dictionary of Terms in Art* (1854); etc. D. Apr. 3, 1866.

Fair Isle: a solitary isle, 4 by 2½ miles in extent, between Orkney and Shetland. It rises 408 feet above the sea, and is accessible for ships only at one point, on the S. E. In 1588 the Duke of Medina Sidonia, admiral of the Spanish Armada, was wrecked here, and most of his crew were murdered. Lat. 59° 33′ N., lon. 1° 38′ W.

Fairlamb, James Remington: See the Appendix.

Fair Oaks, or **Seven Pines**, Battle of: a battle fought May 31 and June 1, 1862, at Fair Oaks, Va., a station on the Richmond and York River Railroad, where it is crossed by the Nine Mile road, about 6 miles from Richmond. The junction of the Nine Mile and Williamsburg roads, about a mile S. E. of Fair Oaks, is called Seven Pines (hence the alternative name of the battle). McClellan, moving from Yorktown viâ White House, had reached the Chickahominy, and on May 27 Keyes and Heintzelman's corps were on the south (right) bank of this stream, their front extending from Fair Oaks to Seven Pines, while Sumner's, Franklin's, and Porter's corps were on the north (left) bank, the line extending up to Mechanicsville.

McDowell at Fredericksburg was reported to be marching southward to join McClellan. Gen. Johnston, commanding the Confederate army, disposed his troops to attack the Union right wing near Mechanicsville, on May 29, before McDowell's arrival. Before the attack was made he was informed that McDowell had turned back toward Washington, whereupon he changed his plans and attacked the Union left wing, consisting of the two corps south of the Chickahominy, with a view to destroying this wing before it could be re-enforced from the right, which was separated from it by the river, much swollen by recent rains. To overwhelm the Union left wing, he designed to reinforce his right wing under Gen. D. H. Hill with the divisions of Gens. G. W. Smith and Longstreet, which had been massed on his left for the attack previously contemplated. Owing to some misunderstanding of orders, Longstreet's division was marched and countermarched in rear of the Confederate army in such a way that less than half its brigades came into action that day; and by occupying the roads it delayed the movements of other troops. This, in connection with some errors in transmitting orders, prevented the attacks being made simultaneously along the Union left wing. About 1 p. m. D. H. Hill on the Confederate right began the attack, drove in the pickets, and by successive advances forced back the Union line about 2 miles to a position between Seven Pines and Savage's Station, where at about 6 p. m. a line was formed which was held, and during the night was strengthened by intrenchments. Meanwhile McClellan ordered Sumner's corps to cross the Chickahominy and re-enforce Keyes. Sumner starting at once, and marching toward Keyes's right, met and repulsed the attack just made by Gen. G. W. Smith's troops upon Couch, who was on the extreme right of Keyes's command and separated by some distance from the troops on his left. Fighting for the day closed at about 6.30 p. m. in this part of the field, and the Union lines were made continuous and strengthened during the night.

On the morning of the next day (June 1), after some preliminary skirmishing commencing at about 5 a. m., the Confederates at about 6.30 a. m. made a determined attack upon the Union left center situated upon the railroad, about half a mile east of Fair Oaks. After about an hour and a half of fighting this was repulsed. Subsequently a second was made, which continued about an hour, when the Union troops charged upon the Confederates, and, driving them back, advanced and reoccupied the line from Fair Oaks to Seven Pines. No further pursuit was attempted, and the fighting ceased at about 1 p. m. The aggregate strength of the three corps of the Union army engaged was 51,543, that of the four Confederate divisions about 39,000. The numbers in the front or fighting lines were about 20,000 on each side.

The total Union losses in killed, wounded, and missing were 5,031. The Confederate losses 6,134. See *The Battle of Seven Pines*, Gen. G. W. Smith: articles by Gen. Johnston and Gen. Smith in *Battles and Leaders of the Civil War*; *The Peninsula*, by Gen. Webb; and the *Official Records*. James Mercur.

Fairport: village; Monroe co., N. Y. (for location of county, see map of New York, ref. 4–D); on the New York Central and West Shore railways, and on the Erie Canal; 11 miles E. of Rochester. It has 7 churches, 2 union school-buildings, a flouring-mill, a furnace, a large shoe-factory, marble-works, 3 planing-mills, 2 fruit-canning establishments, and manufactures of barrels, staves, agricultural implements, carriages, confectionery, saleratus, cream of tartar, baking-powder, etc. Pop. (1880) 1,920; (1890) 2,552; (1900) 2,489. Editor of "Monroe County Mail."

Fairy-lore: a name sometimes given (on the analogy of folk-lore) to the body of popular beliefs, often oddly inconsistent, about various supernatural beings known as *fairies.* The term *fairies* is used very loosely, being often applied not only to such diminutive, sylph-like creatures, tricky but not malevolent, as Shakspeare has drawn in *A Midsummer Night's Dream*, but to the dwarfs, elves, and kobolds of German popular tales, many of whom are earthy and malicious, the fées of Celtic (and French) romance, who are beings of human stature and more than mortal power and beauty, and the genies or *djinns* of Arabian story. Indeed, almost any kind of supernatural being not accounted for in the creeds of Christendom, and not exalted enough to be regarded as a heathen god, has been included under this general term—apparitions of the dead excepted. It follows that there can be no satisfactory statement of the origin of fairy-lore. Some of it is due to ancestor-worship, some to misinterpreted natural phenomena, some to the survival in a degraded condition of divinities dethroned by Christianity. Much of it may be the detritus of myth; more is assuredly the raw material of myth. It is always influenced by climate, natural scenery, and manner of life; and sometimes, even in Christian countries, it stands in a curious relation to the popular, as opposed to the educated, religion. (See also Folk-lore and Mythology.) The term *fairy-tales* is often used in English as an equivalent for the German *Märchen*, and is thus not infrequently applied to stories in which fairies play no part.

Bibliography.—Works on the folk-lore of a country usually contain something about its fairy-beliefs, and the folk-lore journals contribute much that is of interest. The following books and articles may also be consulted: Allies, *On the Ignis Fatuus*, etc. (London, 1846); J. T. Bunce, *Fairy Tales, their Origin and Meaning* (London, 1878); F. J. Child, *English and Scottish Popular Ballads* (Boston, 1882 ff.); R. H. Cromek, *Character of the Lowland Scotch Fairies*, in his *Remains of Nithsdale and Galloway Song* (1810); Jacob Grimm, *Deutsche Mythologie* (4th ed. Berlin, 1875–78); Wilhelm Grimm, *Einleitung über die Elfen*, in his *Kleine Schriften* (1881, i. 405–490); J. O. Halliwell, *Illustrations of the Fairy Mythology of A Midsummer Night's Dream* (London, 1845); E. S. Hartland, *The Science of Fairy Tales* (London, 1891); W. Hertz, *Die bretonischen Feen*, in his *Spielmannsbuch* (Stuttgart, 1886); T. Keightley, *The Fairy Mythology* (London, 1833; new edition 1850); W. Mannhardt, *Wald- und Feldkulte* (Berlin, 1877); L. F. A. Maury, *Les Fées du Moyen Âge* (Paris, 1843); J. Ritson, *Fairy Tales* (London, 1831); H. Schreiber, *Die Feen in Europa* (Freiburg im Br., 1842); Sir Walter Scott, *On the Fairies of Popular Superstition*, in his *Minstrelsy of the Scottish Border*; the same, *Letters on Demonology and Witchcraft.* Compare also the references in an article on *Sir Orfeo*, in *The American Journal of Philology*, vol. vii., No. 2. The relations of fairy-lore to Germanic mythology are well set forth by E. Mogk in his article *Mythologie*, in Paul's *Grundriss der germanischen Philologie.* G. L. Kittredge.

Fairy-rings: imperfectly circular or annular patches in grass-land in which the vegetation is either richer or more scanty than that around it. They are common in the British islands and other parts of Europe, where, according to folk-lore, they are caused by the dancing of fairies. They began to attract the attention of scientists in the latter part of the eighteenth century. At first they were considered to be the effect of lightning. After much investigation, however, and not a little debate, it was shown that they are caused by the growth of *Agaricus* and other fungi, which spread from the center outward, and at first check, but afterward by their decay accelerate, the growth of the grass. They are also found in Western U. S.

Faith [M. Eng. *feith*, *fayth*, *fay* from O. Fr. *feid*, *feit*, *fei* > Fr. *foi* : Span. *fe* : Ital. *fede* < Lat. *fides*, deriv. of *fi'dere*, to trust : Gr. πείθειν, πιθεῖν, to persuade : Teuton. *bid-*, to ask < Indo-Eur. *bheidh*, *bhoidh*, *bhidh*]: belief, conviction, assurance, or trust, resting on any sort of evidence whose force is affected subjectively—that is, by the mental condition of the recipient. An assurance resting on purely objective grounds relies upon the common state of all minds, not on the special condition of any, and involves knowledge. Man *believes* there is a God, but there are temptations to unbelief which have led men to atheism. He *knows* that twice two are four, and it is not possible to tempt him to doubt it. One and the same thing may be an object of faith at one stage of evidence, and of knowledge at another. There may be a subjective difficulty which is invincible to the sort and degree of evidence which is ordinarily sufficient for faith, yet is overcome by the evidence which produces knowledge. The mind may pass therefore from unbelief to belief, from belief to knowledge, or from unbelief to knowledge. It may pass from unbelief to belief without addition to evidence, solely by change in itself. but it can not pass from either to knowledge, except by additions to evidence. The faith of one man may rest on the presumed knowledge of another, and thus be confounded with knowledge itself. The great body of scientific fact is actually the object of knowledge to a few, and is supposed to be a part of the knowledge of the many only because the many have faith in the statements of the few, though they can neither verify them, nor even understand the processes by which they are reached. "We *believe*," says Lewes (*Problems*, i. 21), "that the sensation of violet is produced by the striking of the ethereal waves against the retina more than seven hundred billions of times in a second. . . . These statements are accepted *on trust* by us who know that there are thinkers for whom they are irresistible conclusions." Knowledge involves intellectual *coercion*—faith involves *freedom*. One is not *responsible* for the fact that under the conditions of knowledge he *knows*, or in defect of them does not know; he is responsible if under the conditions of a well-grounded faith he disbelieves. In the history of philosophy the names of Hobbes, Huet, Leibnitz (*Faith and Reason*), d'Alembert, Kant, and Daub are connected with special views of faith.

In theology the relations of faith to knowledge and the question of precedence have long been agitated. Augustine and his school held that faith precedes understanding; Jacobi confessed that to him the dualism of the two was hopeless; Hegel proposed to relieve the antagonism by absorbing faith into knowledge; Schleiermacher says they are the two foci of one ellipse. In the Bible, faith is by pre-eminence trust, a conjoint movement of the intellectual powers, the affections, and the will. Its object is the supersensuous, God, and God in Christ. It involves knowledge or mental vision, voluntary reception, personal adhesion, and obedience. The Scholastics distinguish between believing that God is, believing God, and believing *in* God. Faith *informis* is merely intellectual; faith *formata* involves love, and is a virtue. Faith was regarded as a general intellectual assent to revealed truth as interpreted by the Church. In contradistinction to this, the Reformers laid stress on faith as a personal assurance of the forgiveness of sins for Christ's sake. This faith involves knowledge, assent, and trust. It justifies not by the merit, or on the ground of the works which follow it, but as the medium, the hand which lays hold of and appropriates Christ and his merit. See JUSTIFICATION. Revised by S. M. JACKSON.

Faith, Articles of: See FAITH, CONFESSIONS OF.

Faith, Confessions of: official statements of doctrine—"symbols" in the theological sense. As distinguished from creeds, confessions of faith are fuller presentations. We speak of the Apostles' Creed, the Westminster Confession. In the extent of reception they are (1) œcumenical, catholic, or general, as accepted by the whole Church catholic; (2) particular, as accepted by particular parts of the Church. The term has also been applied to the carefully prepared statement of the faith of individuals. Articles of faith are the separate parts of confessions. A confession is an organic body or *corpus* of faith, its parts are members or *articuli*, such as the articles concerning God, sin, Christ, the Church. See the articles on the particular systems, as ARMINIANISM, etc., on the confessions, as the AUGSBURG CONFESSION, etc., and on the various churches.

Faith, Rule of (in Lat. *Fidei Regula*): that to which faith appeals as its source and guide. *Why* do I believe this or that? and *what* am I bound to believe? are questions answered by the rule of faith, while the confession of faith, as such, simply states what I do believe. The confession is drawn from the rule. In the Roman Catholic Church the rule of faith is the body of revealed truth embraced in Holy Scripture and tradition (in libris scriptis et sine scripto traditionibus—*Council of Trent*, Sess. IV.), in the sense in which the Church holds that truth. In the Protestant churches the canonical Scriptures are regarded as the sole rule of faith.—RULE OF FAITH, ANALOGY OF FAITH, have been applied also from very ancient times to the body of most necessary and saving doctrines, so explicitly and clearly set forth in the Scriptures as to form a general guide in interpreting the more obscure parts. The APOSTLES' CREED (*q. v.*) was frequently so styled by the Fathers. The *Regula Fidei* is valid on the assumption that there is absolute unity in all parts of the doctrinal teaching of the Bible.

Faithfull, EMILY: philanthropist; b. at Headley rectory, Surrey, England, in 1835; educated at Kensington; at an early age became interested in the condition of women, and devoted her time to extending their sphere of labor, establishing in 1860, in spite of great opposition, a printing establishment in which women were employed. Queen Victoria gave this project her approval, a printing business was formed styled "The Victoria Press," and Miss Faithfull was appointed publisher in ordinary to the Queen. In 1863 the *Victoria Magazine* was begun, and for eighteen years was devoted to the claims of women to remunerative employment. Miss Faithfull published in 1868 a novel entitled *Change upon Change*. Soon after she appeared as a lecturer on her favorite topic, and in 1872 and 1882 visited the U. S., where her lectures were favorably received. See her *Three Visits to America* (1884). D. in London, June 3, 1895.

Faithorne, WILLIAM: engraver; b. in London, England, about 1616; was imprisoned as a loyalist, and then banished from England under Cromwell. He went to France and studied engraving. From 1650 to 1680 he was a printseller in London, and died there in May, 1691. He engraved a large number of portraits, chiefly from his own studies, and of great historical and considerable artistic value; also for Taylor's *Life of Christ, Christ at Prayer in the Garden of Olives, The Marriage at Cana in Galilee*, etc., and wrote a treatise on the art of engraving.

Faizabad, fī-zaa-baad', or **Fyzabad**: a commissionership, district, and town of Oudh, British India, now within the jurisdiction of the Northwest Provinces. The commissionership is S. of Nepal, between the parallels 26° and 29° N. and the meridians 81° and 84° E. Area, 7,671 sq. miles. Pop. 3,500,000. The district is on its western side, S. and W. of the Gogra and E. of the Gumti rivers. The area is 1,649 sq. miles, and the population a little over 1,000,000. It is an historical district, celebrated for its calamities and antiquities. It is traversed by a railway, has an important trade, raises principally rice and wheat, and is now prosperous. The city is the chief town and capital of the district, and is on the right bank of the Gogra, in lat. 26° 47′ N. (see map of N. India, ref. 6–F). A suburb of the city is Ajodhya, a very ancient town, formerly great, and still celebrated in Sanskrit literature. Faizabad was for a time the capital of Oudh, but in 1775 the capital was removed to Lucknow, and it rapidly decayed. It is reviving under British rule. Pop. (1869) 37,804; (1891) 79,500.

Fajardo: See the Appendix.

Fakir, fay'ker or faa-keer' [from Arab. *faqīr*, poor man]: one of a class of religious mendicants in India, found there in large numbers and with evidence of their existence very early in Hindu history. Some of them are ascetics, who practice surprising mortifications and bodily tortures, such as swinging on hooks thrust through their flesh, lying on a bed of spikes, walking on sandals through which spikes are driven, hanging suspended during life before a slow fire, fulfilling a vow to continue in one position during life, holding the limbs in a fixed position till they become immovable, carrying a cumbrous load or drawing a heavy chain, crawling on their hands and knees for years, rolling on the earth from one end of the land to the other, etc. By these means they acquire a reputation for sanctity which gives them a great hold upon the superstitions and the fears of their countrymen, though there is little religious sense displayed in all these performances, which are adopted, for the most part, as a mode of obtaining notoriety or a livelihood. The Hindus have apparently little respect for these men, but they dread their curses, and the powerful rajah will rise up on his elephant and salute one of these "saints" as he passes by.

Falaise, faa'lāz' [O. Fr. *faloize* and *falize*, from O. H. Germ. *felisa*, rock, cliff > Mod. Germ. *Fels, Felsen*]: town of France; department of Calvados; 22 miles S. S. E. of Caen (see map of France, ref. 3–D). It is picturesquely situated on a lofty platform bordering on a rocky precipice (*falaise*), which position made it a very strong fortress in olden times, before the invention of gunpowder. Its old castle, now mostly in ruins, was the seat of the Dukes of Normandy and the birthplace of William the Conqueror. There are manufactures of cottons, hosiery, and bobbinet, and dye and tan works. Pop. (1896) 8,163.

Falashas [the name signifies wanderers or exiles]: a strange people in Abyssinia inhabiting the mountainous regions of Samen and the plains along Lake Tzana, and numbering about 100,000. They are the remnant of natives who were converts to Judaism. The name *Falashah* signifies exile or wanderer, and they have been much oppressed by the neighboring Christians. However uncertain their origin, they have become thoroughly Abyssinian, and are distinguished from their fellows only by their religion. Like the native Christians, they are well formed, and resemble the nomads of Arabia. They are of medium height, with face oval, nose finely sharpened, mouth well proportioned, lips properly formed and by no means exuberant, sparkling eyes and well-set teeth, and hair somewhat curled or straight. (See Figuier, *Les Races Humaines*, Paris, 1872, p. 406.) Until the beginning of the nineteenth century they constituted an independent tribe, and were governed by their own prince; it is said that in the tenth and twelfth centuries they even ruled over the Abyssinians. They were subjected by the Amharas about 1800, and are now under the rule of the princes of Tigré. The Falashas speak both the Amharic and a dialect of the Agaon tongue, and are very industrious, devoting themselves to the various trades, particularly architecture; also largely to agriculture. Unlike other Semitic races they are averse to commerce, regarding traffic an obstacle to fidelity and rigor in religious observances. The Falashas, although they possess the whole of the Old Testament or Jewish canon (in the Geez language, a sister-tongue of the Hebrew, Arabic, and Aramean dialects and the mother of the Amharic), together with the apocryphal books accepted by the Abyssinian Church, deviate in many instances from Jewish usages. Thus the fringed "praying-scarf" (*taleth*) and the "phylacteries" are not used in their devotions; and while they retain the usage of offering sacrifices, it is rather as commemorative ceremonies than as real sacrifices. The most common is the offering for the repose of the dead; but no sacrifice is permitted on the Sabbath or on the day of atonement. Like other Jews, the Falashahs hope for a return to Jerusalem. Their priests, who live round the inclosures of the temples (which are situated near the edge of the villages, and have more the appearance of the ancient sanctuary than the modern synagogue), observe the laws of purity with rigor, prepare their own food, and keep aloof from the world. They are principally engaged in the education of youth, making the Bible and tradition the basis of their instruction. Polygamy, though tolerated, is nevertheless discouraged. Slave-holding is suffered, but slave-dealing is strictly forbidden. Slaves are kindly treated, instructed in the laws of Moses, and on conversion are manumitted. Attempts on the part of the London Missionary Society and the Scottish Church Mission to convert the Falashas to Christianity induced the Jewish Alliance Universelle in 1867 to send among them M. Halévy, of Paris, to secure their education and to counteract the Christianizing influence of the missionaries. See, besides works on Abyssinia, Hotten, *Abyssinia and its People* (London, 1868); J. M. Flad, *The Falashas of Abyssinia* (Eng trans. 1869); J. Halévy, *Travels in Abyssinia* (Eng. trans. 1878).

James H. Worman.

Falcid'ian Law: a law under the civil or Roman law system, proposed by a tribune, Falcidius, about 40 B. C., by which it was enacted that testators should not have power to dispose of more than three-fourths of their property by will, and that the remaining one-fourth should descend to the heir. This fourth was termed the "Falcidian portion." No such restriction exists at common law, a testator having an unqualified power to distribute his property entirely among strangers, and leave his family unprovided for if he desires. In the U. S. Louisiana, which has adopted the civil law, has a provision similar to the Falcidian law. In some of the other States restrictive enactments have been made in regard to bequests to charitable corporations or associations. For instance, in New York a testator having a husband, wife, child, or parent living can leave to such institutions only one-half of his property after the payment of his debts. *Laws* 1860, ch. 360.

Falck'enstein, Eduard Vogel, von: Prussian general of infantry; b. in Silesia, Jan. 5, 1797. He was the son of a Prussian major, but the father died early, and the mother, unable to educate the boy herself, asked assistance from her relative the Prince-Bishop of Breslau. The prince-bishop promised to help, but on the condition that the boy should be a clergyman. But at the rising of the Prussian people against Napoleon, in 1813, the boy left the ecclesiastical career and entered as a volunteer into the West Prussian Grenadier battalion of Col. von Klück. He distinguished himself in the battle of the Katzbach, and at Montmirail, when all the officers had fallen, he led the battalion with imperturbable calmness, though a youth of hardly seventeen years. After the war he studied topography with great zeal, and founded a school for glass-painting in Berlin under the auspices of Friedrich Wilhelm IV. On Mar. 18, 1848, in the riots in Berlin, he was wounded, but took part in the same year in the campaign in Holstein, and became commander of the foot-guards in 1849, and in 1851 colonel and chief of the staff of Wrangel. He held the same position in 1864 during the second war with Denmark, but after the war he was made commander-in-chief of the Seventh Army-corps. In the war of 1866 he commanded against Hanover, Hesse, Nassau, Baden, Würtemberg, and Bavaria, and displayed considerable strategic talent. After the war he received a dotation, was elected to the North German Diet by the city of Königsberg, and spoke energetically for a triennial military service and a strong military budget. During the war of 1870 he held the chief command of the maritime provinces, and organized the whole defense of the Baltic and of the North Sea. D. in Silesia, Apr. 6, 1885.

Falcon [M. Eng. *faucon*, from O. Fr. *faucon* < Lat. *falco*, name derived from *falx, falcis*, sickle, because of the falcon's curving talons]: a name applied to various species of hawks, but more especially to those of the genus *Falco*, which includes the most active and fearless of the birds of prey. Among the numerous and widely distributed species are the gerfalcons (*Falco candicans* and others), the peregrine falcon, or duck hawk (*Falco peregrinus*), the merlin (*Falco*

Gerfalcon (*F. candicans*).

æsalon), and the hobby (*Falco subbuteo*). The gerfalcons are the most northern of the diurnal birds of prey, inhabiting Greenland, Iceland, and the northern parts of Europe, Asia, and America. The Greenland species (*Falco candicans*) is, when adult, white, with fine black markings on the back and wings; young birds have more black in their plumage. The peregrine falcon is bluish ash above, whitish or dull buff below, with numerous dark spots and bars; it is about 18 inches long and the long, pointed wings have a spread of about 3½ feet. This species, which is found in nearly all parts of the globe, was from its dash and courage particularly dear to the heart of the falconer, and, says Dr. Sharpe, to write its history would be to write the history of falconry. In ornithology the term falcon is usually restricted to the members of the sub-family *Falconinæ*, which may readily be distinguished from the other birds of prey by their notched bills. *Noble falcons* and *ignoble falcons* are terms of FALCONRY (*q. v.*). See FALCONIDÆ and FALCONRY.

F. A. LUCAS.

Falcon, făal-kōn′ (formerly called CORO): the northwesternmost state of Venezuela: bounded N. by the Caribbean Sea, E. by Lara, S. by Los Andes, and W. by Colombia. Area, 36,212 sq. miles. The western and larger portion, forming the section of Zulia, was formerly a state; it was united to Falcon in 1881, but, like other sections, is liable to be erected into a state again with a change of Venezuelan government. As at present constituted, Falcon is divided physically into two nearly equal parts by the great Gulf and Lake of MARACAIBO (*q. v.*). The Gulf of Maracaibo is formed by two peninsulas, that of Guajira on the W., and Paraguaná on the E., the latter connected with the mainland by a very narrow neck. These peninsulas and the shores of the Caribbean Sea are low, sandy, or stony, and form the most sterile region on the Venezuelan coast; owing to the lack of water in the dry season, artificial cisterns are everywhere used. Around Lake Maracaibo the country is low and partly swampy. Inland there are mountains of no great height, with considerable forests, and the valleys are very fertile. The climate everywhere is warm, but generally healthy. Pop. (1891) estimated at 224,566. The most important products are tobacco, coffee, cacao, and goatskins. Principal towns, Coro and Maracaibo. The capital, Capitarida, on the Gulf of Maracaibo, has about 2,000 inhabitants.

HERBERT H. SMITH.

Falcon, JUAN CRISÓSTOMO: Venezuelan general and statesman; b. on the peninsula of Paraguaná, province of Coro (now Falcon), 1820. He early entered the army; fought with the *progressistas* in 1846, and against Gen. Paez in 1848. In 1849 he defeated and captured Carmona at La Bacoa. In 1858 he headed the federalist revolution in his native province of Coro; driven out in 1860, he returned in 1862, and was finally successful, entering Caracas July 29, 1863. He was elected president of Venezuela, with Guzman Blanco as vice-president, and in 1864 he sanctioned a new constitution. The *Azul* revolution of 1867 resulted in his overthrow, after three days' battle in the streets of Caracas (July 24–26). He retired to Europe; a counter-revolution, headed by Guzman Blanco, put his party again in power, and he was recalled, but on his way back died at Martinique, Apr. 29, 1880. HERBERT H. SMITH.

Falconer, HUGH, M. A., M. D., F. R. S.: botanist and palæontologist; b. at Forres, Scotland, Sept. 29, 1808; graduated M. A. at Aberdeen 1826; M. D. at Edinburgh 1829; went to India as a surgeon 1830; began palæontological explorations in the Siwalik Hills 1831; became superintendent of the botanical garden at Seharanpoor 1832; received the Wollaston medal 1837; became F. R. S. 1845; superintendent of the botanical garden at Calcutta 1847; published *Selections from the Bostân of Saadi* (1838); *Fauna Antiqua Sivalensis* (1846, with T. P. Cautley); *Palæontological Memoirs* (1868). D. in London, July 31, 1865.

Falconer, JOHN M.: See the Appendix.

Falconer, WILLIAM: poet; b. in Edinburgh, Feb. 11, 1732; son of a barber; became a sailor, and is best known by his poem, *The Shipwreck* (1762; new ed. 1804, 1872). He published also a universal *Marine Dictionary* (1769; new ed. 1815), and various minor poems. Lost at sea in 1769 off the coast of Mozambique, while purser of the frigate Aurora.

Falconet [dim. of FALCON, *q. v.*]: in falconry, a male falcon, smaller and weaker than the female.

Falcon′idæ [mod. deriv. of Lat. *fal′co, falco′nis*, falcon]: a family of *Raptores*, containing all the *Accipitres*, or diurnal birds of prey, except the secretary bird and the vultures of the New World. The members of the family are characterized by the presence of a bony septum between the nostrils, legs of moderate length, strongly hooked bill, sharp, curved claws, and, save the vultures, a well-feathered head. The family is divided into the following sub-families: *Vulturinæ*, the Old World vultures; *Aquilinæ*, the eagles; *Pandioninæ*, the fish-hawks; *Circinæ*, the harriers; *Milvinæ*, the kites; *Polyborinæ*, the carrion hawks; *Accipitrinæ*, the hawks; and *Falconinæ*, the true falcons. The fish-hawks are by some authorities placed in a family by themselves. F. A. LUCAS.

Falconry: the art of capturing, rearing, and training falcons for the chase of other birds, and even of small quadrupeds. The name *falconry* was also applied to the aviary or inclosure where the falcons were kept. The practice of hunting with falcons was introduced into Europe from the East. Ctesias alludes to the existence of such a custom in India in his time; Marco Polo also, in his *Milione*, speaking of the Tatars, says that their great khan "took with him full ten thousand falconers and good five hundred ger-falcons, with falcons *peregryne* and falcons *sacre* in great abundance; also he had a great number of goshawks for fowling along the waters," etc. Hawking seems to have passed over from the Tatars to the czars of Muscovy, who took great pleasure in this amusement. (See *Prince Serebrianni*, by Alexis Tolstoi, London, 1874). In Europe this pastime is anterior to the Middle Ages, as, among the later Romans, Martial, Apuleius, and Julius Firmicus make special mention of it. On the descent of the Lombards into Italy, hawking became much more general, and from this it may be inferred that the ancient Germans were acquainted with it. Charlemagne took great delight in it, and he is said to have kept as many falconers as huntsmen. Pope Gregory IX. appears to have kept falcons. Henry the *Fowler* received his surname from his passion for this sport. The Emperor Frederic II. not only enjoyed hunting with falcons, but he was a master of the art, and even wrote a treatise upon it, annotated by his son Manfred, with the title *De arte venandi cum avibus.* Another treatise on the same subject is attributed to Edward the Confessor of England. Brunetto Latini, in his *Tesoro* (chs. ix., x., xi., xii.), speaks of falconry; Dante reminds him of it in the *Divina Commedia.*

In the language of falconry the term *noble falcon* designates those birds of whatever species which may be trained for use in hawking; the rest are *ignoble.* Others designate the high-flying falcons which stoop upon the prey as *noble*, while those which fly low, chasing the prey, are *ignoble.* The most important of the long-winged, high-flying falcons are the gerfalcon, the merlin, the lanner, the peregrine, and the white falcon. Of the ignoble birds may be mentioned the hobby, the goshawk (or falcon gentle), the sparrow-hawk, and certain small species of *Hypotriorchis* and *Ierax*, much used in Asia in hawking. Of these, the more important are noticed in this work under their alphabetical heads. Anciently, the term *falcon* designated only female birds, while the male, always smaller and weaker, was called a *falconet*, or tercel, whatever the species.

The treatise on this subject most interesting to English readers is that ascribed to Dame Julyana Berners, forming the first part of the *Boke of St. Albans*, first printed in 1486. Among the many continental writings upon falconry should be mentioned *La Venerie et Fauconnerie de Jacques du Pouilloux* (Paris, 1535), and the Italian work of Federigo Giorgi, who published in Venice in 1578 a volume entitled *Del Modo di conoscere i buoni falconi, astori e sparvieri, di esercitarli e farli perfetti, di governarli e di medicarli*, describing the various qualities of the falcon and the methods of keeping and caring for it. According to the *Glossary* of Du Cange, the privilege of keeping falcons was, in the Middle Ages, confined to the nobility. This, however, does not seem to have been the case in all countries, for in the *Boke of St. Albans* it is stated that certain falcons belonged by right to certain ranks; for instance: "an Egle, a Bawtere, a Meloune, . . . thyse thre by theyr nature belonge unto an Emperor. A Gerfawkon, a Tercell of a Gerfawkon, are dewe to a kyng. There is a Fawkon gentyll; and a Tercell gentyll; and thyse be for a prynce. There is a Fawkon of the rocke; and that is for a duke. There is a Fawkon peregryne; and that is for an erle." Then follow various other classes, till we come to "the Merlyon; and that hawke is for a lady"; and finally, "there is a Goshawk; and that is for a yoman. There is a Tercell; and that is for a poore man," etc. From this it is evident that in England, at least, the amusement of hawking was not wholly confined to the nobility. The office of grand falconer at the Byzantine court, in that of England, and in the ducal court of Savoy, was one of the highest dignity. Both the art of falconry and the practice of it, hawking, had their special vocabularies or "kindly speche," the thorough knowledge and accurate use of which were thought highly important as a test of good-breeding and as a means of distinguishing "a gentylman fro a yoman, and from a yoman a vylayne."

A great number of these terms and much other quaint matter on this subject will be found in the *Boke of St. Albans* and the other treatises above quoted. In the fifth chapter of Cibrario's *Della Economia Politica del Medio Evo* is a full description of this sport: "The time of the chase was either early in the morning or toward evening. The sportsmen rode out, with their falcons resting upon their strongly gloved wrists. When a bird was discovered suited to the nature and the habits of the falcon, the little hood which covered its eyes was drawn off, and the falcon rose in rapid circles high above its destined prey; if the quarry was a small bird, she then suddenly swooped (or *stooped*, as the phrase was) directly upon her victim; but if the latter was a large and powerful bird, formidable in beak and wing, the falcon was cautious and cunning in her advances, turned and wheeled with great dexterity, seizing only the favorable moment to strike. Having secured the prize, she swept in large circles over the head of the falconer, and finally presented him the booty; the falconer put it in the game-bag, and then set before his falcon the food prepared for her. Falcons which soared high and pursued birds of lofty flight were called *altani*; others took a lower but more extended range; some were for the inland country, others for aquatic birds. These last were assisted by dogs. When, for example, a flock of herons was discovered, the falconer approached them secretly, and suddenly beat a drum before the herons could get sight of the falcon, otherwise they would not dare to rise. Frightened by the drum, they took to flight; then the sportsman let loose his falcon, and while she prepared to seize the herons in the air, the barking of the dogs prevented the poor birds from hiding again in the water. Eagles and falcons of the largest species may be trained for this chase, and they will even take foxes and hares." With Eastern sovereigns hawking is still in great favor, but it has almost entirely disappeared from Europe. The rare occasions in which the falcon is now employed are rather scenic representations of the old custom than attempts to revive it. The history of this pastime is especially interesting, as being almost the only outdoor amusement in which women of rank, in the Middle Ages, took an active part, and it has furnished the writer of fiction with many a romantic situation, the poet and the painter with many a happy illustration. See Freeman and Salvin, *Falconry, its Claims, History, and Practice* (London, 1859); Harting, *Hints on the Management of Hawks* (1884). ANGELO DE GUBERNATIS.

Faleme, fā-lā'mā: a river of Senegambia, Western Africa. It is one of the most important tributaries of the Senegal, which it joins in lat. 14° 40' N., lon. 11° 48' W.

Fale'rii: powerful city of ancient Etruria; situated N. of Mt. Soracte and W. of the Tiber. It is believed to have been one of the twelve cities of the Etruscan confederation. It was often at war with Rome, but in 241 B. C. was conquered and destroyed by that power. A new Roman Falerii was founded near by, the ruins of which, 5 miles distant from Nepi, are of great interest. The old Falerii probably stood at Civita Castellana.

Faler'nian Wine [from Lat. *Falernus*, pertaining to the Falernus Ager, or Falernian District in Campania]: the most celebrated of the wines of the ancient Romans. According to Pliny, it was of three varieties—a light, a sweet, and a dry. It was very strong and generous, so that it would take fire from a lighted taper. When new it was very harsh and unpleasant. The excellent Massic wines came from the same region, and the two sorts were often confounded. Indeed, the better qualities were called indiscriminately by either name. These regions still produce good wine. From all accounts, the Falernian must have resembled the modern sherry wine.

Falguière, fāal'gee'ār', JEAN ALEXANDRE JOSEPH: sculptor and figure-painter; b. at Toulouse, France, Sept. 7, 1831. Pupil of Jouffroy; Grand Prix de Rome (sculpture) 1859. His work in both branches of the fine arts is strong, and possesses qualities of the highest order. In sculpture, *Diana*, *Christian Martyr* (1868), and *Victor in the Cock-fight* (1870), the last two in the Luxembourg Gallery, Paris, are among his best works. In painting, *The Wrestlers* (1874), *Susanna*, *Slaughter of a Bull* (1881), and *Fan and Poignard* (1882; Luxembourg Gallery) are celebrated. Member of the Institute; medal of honor (sculpture) 1868; officer Legion of Honor 1878. Studio in Paris. W. A. C.

Faliero, fāa-lēe-ā'rō, or **Falieri**, fāa-lēe-ā'rēe, MARINO: doge of Venice; b. of an eminent family in 1274; served the republic in war and on important embassies, and in 1354, when seventy-nine years old, was chosen to the dogate, soon after which the Venetian fleet was lost in a great battle with the Genoese. Not long after, at a carnival feast, his wife was grossly insulted by a young nobleman, and in revenge Faliero determined to destroy the whole body of nobles, who were detested by the people, and become sole ruler. His conspiracy was detected and suppressed, and the doge, after a full confession, was beheaded Apr. 17, 1355. His story has been a favorite one with the poets, dramatists, and musical composers—Byron, Delavigne, Hoffman, Donizetti, and others.

Falk, faalk, PAUL LUDWIG ADALBERT: statesman; b. in Matschkau, Prussia, Aug. 10, 1827; educated at the Gymnasium and University of Breslau; studied law and became a member of the Prussian House of Deputies 1858–61. He was Minister of Worship and Education 1872–79, and in 1882 was nominated to the presidency of the supreme court in Hamm. During his administration of the Department of Worship and Education he passed several rigorous measures directed against the hierarchy and clergy. (See FALK LAWS.) Bismarck at first sustained this legislation, but subsequently made some advances to the ultramontane party in order to gain their support, and Falk was forced to resign. D. July 7, 1900. C. H. THURBER.

Falkirk, faw'kirk: city of Stirlingshire, Scotland; 25 miles W. N. W. of Edinburgh; on the Edinburgh and Glasgow and Scottish Central Railway, near the old Roman wall of Antoninus and the well-known Carron Iron-works (see map of Scotland, ref. 11–H). It contains, among other institutions, a science and art school, a free library, and a cottage hospital. Its three annual "trysts" at one time were the largest cattle-fairs in Scotland, sales being made to the amount of nearly £1,000,000. These have been largely superseded by weekly auctions. In 1298 Sir William Wallace was defeated here by Edward I., and in 1746 the Highlanders, under Prince Charles Edward, defeated the royal troops. Pop. (1891) 16,615; with suburbs, 25,000; (1901) 29,271.

Falkland, fawk'land: royal burgh of Fife, Scotland; 22 miles N. of Edinburgh (see map of Scotland, ref. 10–H). It is situated at the base of the Lomond Hills, which rise so abruptly behind it as to intercept the rays of the sun from it for several weeks during winter. The remains of Falkland Palace are very interesting, both in architectural respects and on account of their connection with the history of James IV. and James V. Pop. 3,000.

Falkland, LUCIUS CARY, Viscount: son of Sir Henry Cary, a man of literary tastes; b. probably at Burford, Oxfordshire, in 1610; educated at St. John's College, Cambridge. In 1633, upon the death of his father, Lucius succeeded as viscount, and was made by King Charles gentleman of the royal bedchamber. In 1640 he was chosen member of the Short Parliament, and was re-elected to the Long Parliament. Opposed to what seemed to him the excesses and illegalities of the popular party, he entered the lists in defense of the king, and in 1642 became Secretary of State. When civil war broke out he joined the king, fought admirably at the battle of Edgehill, and was killed at the battle of Newbury, Sept. 20, 1643. He wrote various treatises, of which is best known the *Discourses of the Infallibility of the Church of Rome* (best ed. London, 1660, 4to). A volume of poems by Falkland, edited by A. B. Groshart, was published in 1871.

Falkland Islands (MALVINAS or MALUINAS of the Spanish): an archipelago in the South Atlantic Ocean; 300 miles E. of the Straits of Magellan; between 51° and 52° 45' S. lat., and occupying about seven and a half degrees of longitude. Entire area, about 6,500 sq. miles, of which 3,000 is in the island of East Falkland and 2,300 in West Falkland; besides these there are over 100 small islands and numerous islets and rocks. Nearly all are high, and in the interior of the two larger islands there are several peaks rising above 2,000 feet. The coasts are much broken, with numerous deep fiords and some excellent harbors. The climate is severe, owing rather to the frequent storms than to cold. The indigenous fauna and flora are both very poor. There are no trees. Hardly any of the land is fit for cultivation, but it affords excellent pasturage. Sheep-farming is the principal and almost the only industry. The Falklands, with SOUTH GEORGIA (*q. v.*), form a crown colony of Great Britain. The colonists, nearly all of Scotch birth or descent, are industrious and prosperous, and crime is almost unknown. Exports, wool, frozen mutton, sheepskins, and tallow. The trade is mainly with England and Uruguay. Stanley is a free port, except for liquors, wine, tobacco, and a few other articles of luxury. Weights and measures and currency as in England. It is supposed that the islands were first discovered by Davis, in 1592. In 1690 Capt. Strong gave the name Falkland (in honor of Lord Falkland) to the straits, and eventually it passed to the islands. The Spanish name, Malvinas, arose from the great numbers of St. Malo fishermen who formerly frequented the archipelago. The French under De Bougainville formed the first settlement in 1763, but in 1765 Byron seized the islands for England. France transferred her rights to the Spanish, who drove the English out, and the islands remained nominally under the jurisdiction of the viceroys of Buenos Ayres, and later of the Argentine Confederation, but without being settled. The English again took possession in 1833, and the present colony was formed in 1851, but Argentina has never given up her claim to the archipelago. Pop. of the islands (1891) 1,789. Chief town and capital, Stanley or Port Stanley, in East Falkland, with 694 inhabitants.

HERBERT H. SMITH.

Falk Laws, or **May Laws**, **The**: certain measures introduced into the Prussian Diet by the Minister of Worship and Education, Dr. PAUL LUDWIG ADALBERT FALK (*q. v.*). The first of those laws was passed in May, 1872, and transferred the superintendence of the primary schools from the Church to the state by ordering that the inspector of schools should be a layman, and a ministerial order of June of the same year almost completely excluded the Roman Catholic Church from exercising any influence on the schools by forbidding the members of the religious orders to teach in them. By a law of Nov., 1872, a supreme ecclesiastical court was established, which enabled the Government to deal in an effective manner with refractory bishops, and another law, of May, 1873, considerably restrained the power of the bishops over the inferior clergy, and the power of the clergy in general over the laity. At the same time, civil marriage was made obligatory, the religious orders living within the boundaries of the Prussian kingdom were forbidden to receive new members, the control of church property was transferred from the clergy to boards of trustees composed of laymen, and a law of May, 1875, required the whole clergy, inclusive of bishops, to sign a declaration of obedience to the laws of the state before entering upon office. The rigor of these laws was relaxed in 1879 and again in 1887.

Falköping, faal'chö-ping: town in Sweden, Westergöthland; 38 miles S. W. of Mariestad (see map of Norway and Sweden, ref. 11–E); known by the battle of 1389, in which the Danish Queen Margrethe conquered the army of the Swedish King Albrecht, and took him prisoner. This victory led to the famous Union of Kalmar, 1397, by which Sweden, Norway, and Denmark were united under one crown.

Falkner, fawk'ner, THOMAS: Jesuit missionary; b. in Manchester, England, Oct. 6, 1707. He studied medicine and became surgeon on a slave-ship, in which he sailed to Africa and thence to Buenos Ayres; there he fell sick and was kindly cared for by the Jesuit fathers of the colony. In May, 1732, he entered their order, and for thirty-eight years he was employed as a missionary, at first in Paraguay and Tucuman, and after 1740 among the wild tribes of Patagonia. After the Jesuits were expelled from South America (1767) he resided in England, where he was chaplain to several distinguished Catholic families. He wrote two works on South America, and a Latin treatise on surgery, all of which probably are lost, but a compilation from his papers was published in 1774 as *A Description of Patagonia and the Adjoining Parts of South America*. Of this there are German, French, and Spanish translations. D. at Plowden Hall, Shropshire, Jan. 30, 1784. HERBERT H. SMITH.

Fallacy [Mid. Eng. *fallace*, from Fr. *fallace*, deception < Lat. *falla'cia*, deriv. of *fal'lax*, deceitful, deriv. of *fal'lere*, deceive]: in logic, a wrong notion resulting from an incorrect performance of the process of reasoning. Not every wrong notion is a fallacy. If the process of reasoning is performed correctly, and the wrong notion rises either from a biased and prejudiced assumption of distorted premises or from a weak and groping confidence in insufficient premises, it is in the first case an error—in the latter, a mistake.

As the whole process of reasoning can be reduced to the making of inferences, and as the fundamental character of all inferences is the syllogism, the fallacy may be defined as the result of some fault in the formation of the syllogism. And furthermore, as all faults which can be committed in the formation of a syllogism rise either from the two propositions being repetitions of each other, and consequently incapable of producing any legitimate third proposition, or from their being wholly incongruous, lacking the true middle term, which alone could draw the premises together into a conclusion, all fallacies fall into two classes corresponding to these two divisions of faulty syllogisms, and may be characterized either as a reasoning in a circle or as a jumping to the conclusion.

The first kind of logical fallacy, the reasoning in a circle —which in the terminology of the old logical systems was called a *petitio principii*—consists in proving one position by assuming another which is identical with it. Of all kinds of logical fallacies this is the most desperate. When a person is caught by such a fallacy, debate must stop; when an age is caught, civilization must stop. It acts on the mind like a magical ring. A person or an age may move around in it, with steadily increasing passions, and there is no escape from it unless through a revolutionary concussion of the whole mind. It is of most frequent occurrence in theological matters, and in those questions of politics which it seems impossible to solve satisfactorily by the mere application of the principle of expediency, without any intermediate agency of moral principles.

The other kind of logical fallacy is much less dangerous, though much more frequent, and comprises a great number of distinct forms, which the old logic describes as the fallacy of the *æquivocatio*, *accidens*, *argumentum ad hominem*, *post hoc ergo propter hoc*, *undistributed middle*, etc. The general characteristic of all these different forms is the application of a middle term composed not of truly constituent, but of merely accidental, qualifications of the two ideas which it is meant to combine. Thus, in a comedy of Holberg, Erasmus Montanus proves that his mother is a stone in this way:

A stone can not fly; you can not fly. *Ergo*, You are a stone.

A more thoroughgoing definition of the terms will, in most cases, be able to destroy this kind of logical fallacy, which, however, has become dangerously frequent in cases in which statistics are applied to the solution of historical or moral questions. Thus Buckle, in his *History of Civilization in England*, reasons as follows: "Necessary laws exclude free will. Statistics show the existence of necessary laws in history. *Ergo*, free will is excluded from history." Any definition of history which in any way can pretend to cover the field which in reality belongs to the idea will break this syllogism to pieces, and show the fallacy of the conclusion.

It must be noticed, however, that even when a fallacy of this kind shows a fault in the construction of the syllogism, thus making the incorrectness of the performance of the process of reasoning perfectly apparent, it generally originates in a willful or unwarranted assumption of premises; and in his book on logic Mill treats fallacies of this kind as errors and mistakes, though he retains the name of fallacy.

Revised by W. T. HARRIS.

Fall Dandelion: See HAWKBIT.

Fallet, NICOLAS: author; b. at Langres, in the department of Haute-Marne, France, in 1753. He was the son of a hatter, and was destined for the bar; but, irresistibly drawn toward literature, he removed to Paris, where he became a contributor to the *Gazette de France*, the *Journal de Paris*, and the *Dictionnaire universel*. Chief among his works are the tragedies *Barnevelt* (1775) and *Tibère* (1783); the comic opera *Matthieu*, represented at Fontainebleau in 1783, and afterward in Paris; *Les fausses Nouvelles*, a comedy; and the two collections of poems, *Mes Prémices* (1773), and *Mes Bagatelles* (1776). D. in Paris, Dec. 22, 1801.

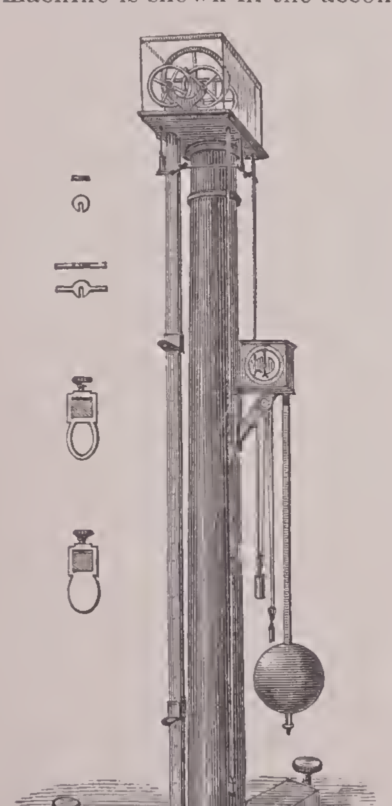
Falling Bodies: The motion of a falling body, assuming it to meet with no resistance from the air, affords the simplest example of uniformly accelerated motion; that is, of a motion the velocity of which increases by equal amounts in equal times. It is found that in the case supposed all bodies fall according to the same law, the velocity constantly increasing at a rate, in north temperate latitudes, of 32·2 feet in a second.

It may be shown mathematically that the general law of uniformly accelerated motion leads to the conclusion that if the distance which the body falls during the first second, or the first unit of time be represented by unity, the distances fallen during the following seconds or other units of time will be 3, 5, 7, etc. If the total distance be computed it will be found that in two seconds a body falls four times as far as in one; in three seconds, nine times as far, etc., the distance increasing as the square of the time of fall.

From this follows another law of the fall, namely, that at the end of any period of time the body is falling with a velocity which, in an equal period of time, would carry it through double the space actually fallen. This is illustrated by the following table, which shows the spaces fallen during the number of seconds, or fractional parts of seconds specified in it, the distances through which the acquired velocity, continued uniform, would carry the body in a time equal to the time of fall, and the acquired velocity (per second) itself:

t = time of fall, seconds or fractions.	s = space fallen, feet and decimals.	d = distance in time t, with vel. = v.	v = vel. acquired by fall, in feet.
0·001	0·000016	0.000032	0·0322
0·01	0·00161	0·00322	0·322
0·1	0·1610	0·3220	3·220
$\frac{1}{8}$	0·2516	0·5031	4·025
$\frac{1}{4}$	1·0062	2·0135	8·050
$\frac{1}{2}$	4·0250	8·0500	16·100
$\frac{3}{4}$	9·0562	18·1125	24·150
$\frac{7}{8}$	12·3284	24·6568	28·175
1	16·1	32·2	32·2
2	64·4	128·8	64·4
3	144·9	289·8	96·6
4	257·6	515·2	128·8
5	402·5	805·0	161·0
6	579·6	1159·2	193·2
7	788·9	1577·8	225·4
8	1030·4	2060·8	257·6
9	1304·1	2608·2	289·8
10	1610·1	3220·0	322·0
12	2318·4	4636·8	386·4
15	4622·5	9245·0	483·0
18	5216·4	10432·8	579·6
20	6440·0	12880·0	644·0

The law of falling bodies is illustrated by a machine invented by George Atwood (*q. v.*). The appearance of the machine is shown in the accompanying figure. An upright column about 8 feet high sustains a small platform on which the essential part of the machine rests. This consists of a light wheel delicately supported upon large friction-wheels and carrying two equal weights suspended at the extremities of a slender and very flexible silken cord, which runs in a groove upon its circumference. While these two weights continue to be equal the system remains at rest, but if an additional weight, however small, be placed upon either, this one will descend, and in descending will generate a velocity in a given time as many times less than that produced in the same time by gravity in bodies falling freely, as the added weight is less than the entire mass moved. It is common, in experimenting with this machine, to employ weights having a definite proportion to this mass. Thus if the whole mass is sixty-four times as heavy as the added weight which furnishes the motive-power, the velocity generated in one second will be the sixty-fourth part of 32 feet (disregarding for the moment the fraction)—that is to say, 6 inches. And as the space fallen through in the first second from rest is only half as great as that which expresses the acquired velocity, the weights of the machine will move only 3 inches in this first second. In preparing for experiment, one of the weights is loaded and raised nearly to the platform at the top of the column, where it is detained by a movable arm brought beneath it, and is held at rest at the zero of a divided scale, shown in the figure, on which the distances of descent are to be noted. A clock, supported by a bracket on the side of the column, is connected with the movable arm above mentioned by a mechanism which causes the arm to drop just as the second-hand marks zero. Sliding on the scale is a small movable brass stage, which may be placed at any point at which it is desired to arrest the fall. And there is also a ring sliding on the same scale, on which the load of the descending weight may rest, leaving the weight afterward to descend unloaded. The forms of the weights used as loads may be seen represented on the left in the figure, where also are given direct views of the stage and ring. The loading weights designed to be arrested by the ring are constructed with arms. The others are simple disks notched to the center, that they may not interfere with the suspending hook and cord. The clock marks the seconds with a loud tick. The moment at which the load is taken off by the ring, or at which the moving weight strikes the stage, is indicated by the sound of the contact. The law of motion is illustrated by noting the points on the scale at which coincidence takes place between these sounds and the beats of the clock. Thus if, as above supposed, the load is one sixty-fourth of the whole moving mass, and the stage is fixed 3 inches below zero, the stroke of the weight on the stage will coincide exactly with the first beat of the clock heard after the movement begins; but in order that coincidence may occur at the second beat, the stage must be placed at four times as great a distance down, or at 12 inches. For coincidence at the third beat the distance must be nine times as great, or 27 inches. In like manner four seconds require sixteen times as great a distance; and five seconds twenty-five times, or 75 inches, which is equal to 6 ft. 3 in. This illustrates the law of uniform acceleration theoretically established above—viz., that the space is as to the square of the time. If, however, the moving weight be unloaded at the distance *three*, by placing the ring at that point, then its subsequent motion will not be accelerated, but uniform, and its velocity will be $2 \times 3'' = 6''$; so that it will take it twelve additional seconds (or thirteen in all) to reach the stage at the seventy-fifth inch—a point which, under the previously supposed conditions, it reaches in five. See Acceleration and Force. S. Newcomb.



Atwood's machine.

Falling Sickness: See Epilepsy.

Falling Stars: See Meteors.

Fallmerayer, fāal-me-rī'er, Jakob Philip: traveler, political agitator, and historical investigator; b. at Tschötsch, in Tyrol, Dec. 10, 1790. His contributions to the history of Greece during the Middle Ages are of great value and include *Geschichte der Kaiserthums Trapezunt* (Munich, 1827); *Geschichte des Halbinsel Morea in Mittelalter* (Stuttgart, 1830–36). He was the first who asserted that the modern Greeks are properly a branch of the Slavonic family of races, and that in spite of their language they have but little of the blood of the ancient Greeks in their veins. D. at Munich, Apr. 26, 1861.

Fall of Man: in theology, the lapse of the first man, and through him the lapse of the race, from the state of integrity into that of corruption. The myths and legends of paganism have many parallels with the scriptural account of the Fall. The tree of knowledge is generally regarded as simply affording the means of testing man, not as having in its fruit any special objective character. The serpent is simply organic and instrumental, the mask of the real tempter, the devil. The sin of the Fall is apostasy from moral fellowship with God, caused by abuse of the freedom of the will, and followed by the loss of the divine image and by liability to temporal and eternal death on the part of Adam and his posterity. Various explanations have been urged as substitutes for the historical sense of the narrative, both in ancient and modern times. The Ophites regarded the serpent as incarnate Wisdom. Many modern German thinkers consider the Fall as a necessary part of man's development in reason and character, "the happiest event in human history." Hase calls it "the image of that which occurs in every man." Nitzsch says, "it is true history, but not actual." See Krauth, *Conservative Reformation*, 376–455, and Hodge, *Systematic Theology*, ii. 123–129.

Fallopian Tubes [named from Fallopius, *q. v.*], or, more properly, **Oviducts**: in the higher animals, two canals in the free margin of the broad ligaments of the uterus, one on either side, extending from the ovary to the uterus. In woman the tubes are each about 4 inches long, with a very narrow passage along the inner half of the length, but much larger outward. The inner end opens into the cavity of the uterus, and the trumpet-shaped outward end opens into the abdominal cavity. The outward end is fimbriated with fringe-like processes, and has been called *morsus diaboli.* The oviducts are identical with what are called Müller's ducts in the fœtus. Birds have but one developed oviduct. In most marsupials each tube serves as a separate uterus. In the higher animals the uterus and vagina are regarded as formed by the union of the oviducts. The function of the Fallopian tubes is to convey the ovum from the ovary to the uterus.

Fallo′pius, or **Fallopio**, Gabriele: anatomist; b. at Modena, Italy, in 1523, or, according to Tomassini, in 1490. With Vesalius and Eustachius (the latter his rival) Fallopius has the honor of being the chief restorer of anatomical science; he taught at Ferrara and Pisa, and in 1551 became Professor of Anatomy and Surgery at Padua and director of the botanic gardens. His name is given to the Fallopian tubes, which he did not first discover (as he was long reputed to have done), though he first suggested their real function. A complete edition of his works was published in 1600. D. at Padua, Oct. 9, 1562.

Falloux, făal′loo′, Frédéric Alfred Pierre, Vicomte de: author and politician; b. at Angers, France, May 7, 1811; became distinguished as a political leader of the Catholic party, but retired from public life in 1851; became one of the editors of the *Correspondant* in 1855; and was known by his *Histoire de Louis XVI.* (1840), a legitimist work; *Histoire de Pie V.* (1844); *Madame Swetchine, sa vie et ses œuvres* (1859); *Madame Swetchine, Journal de sa conversion* (1863); another volume of Madame Swetchine's letters 1866; and some devotional works; also by two volumes of political speeches and writings (1882). D. at Angers, Jan. 6, 1886.

Fallow [probably same word as *fallow*, in *fallow deer*], or **Naked Fallow**: land which is allowed to rest after cropping for one or more seasons with no tillage, except perhaps one or more plowings. The custom is a very ancient one, and is chiefly useful on heavy soils, where it acts probably by way of liberating plant-food from hitherto unavailable compounds. It has, among the best farmers, given way to what is called the green fallow, of which the clover-fallow is one of the best kinds. Some green crop, as clover or buckwheat, is grown and allowed to rot on the surface, or is plowed under. This crop serves to choke the weeds and to fertilize the land, and while growing saves the soil from blowing away and from baking.

Fallowchat: See Wheatear.

Fallow Deer [*fallow* is from O. Eng. *fealu*, pale yellow : Icel. *fölr*, pale : O. H. Germ. *falo*, pale, withered, yellow > Mod. Germ. *Fahl*. Cf. Lat. *palle're*, be pale : Lith. *pálvas*, yellow : Sanskr. *palita-s*, gray]: a species of deer (*Dama vulgaris*); the most common deer of Europe, found also in Northern Africa. Though very common in England, it is supposed to have been introduced there only by the Roman colonists. In a wild state it exists in Southern Europe, but, as remains found in the later Tertiary show, its range originally extended farther N. In summer it is beautifully mottled. The male is called a buck, the female a doe, the young a fawn. The doe is without horns. The venison of the fallow deer is regarded as the most savory known. It is smaller than the stag, and has more spreading and palmated horns. It goes in herds, and each herd has its master, an old buck, which all the others obey.

Fallows, Samuel, D. D.: clergyman; b. at Pendleton, near Manchester, England, Dec. 13, 1835; removed with his parents to Wisconsin 1845; graduated as valedictorian at the University of Wisconsin 1859; became a minister of the Methodist Episcopal Church; entered the army as chaplain 1861; afterward engaged in active military service; reached the rank of colonel and brevet brigadier-general; was seven years a regent of the University of Wisconsin; was State superintendent of public instruction 1870–72; became president of the Illinois Wesleyan University at Bloomington 1874; rector of St. Paul's Reformed Episcopal church, Chicago, May, 1875; editor-in-chief of the *Appeal*, the organ of the Reformed Episcopal Church, Jan., 1876; and was chosen a bishop of the Reformed Episcopal Church July 15, 1876, at the fourth general council of that organization, held at Ottawa, Canada. He has published a *Supplemental Dictionary* (1884) and *Past Noon* (1886).

Fall River: city, port of entry, and important railway and manufacturing center; Bristol co., Mass. (for location of county, see map of Massachusetts, ref. 5–I); in lat. 40° 42′ 3″ N., lon. 71° 9′ 37½″ W.; on the Rhode Island border, on the eastern side of Mt. Hope Bay, the northeastern arm of Narragansett Bay, and along Taunton river, some 20 miles from the sea. It is about 11 miles in length, comprising 41 sq. miles; is 48½ miles S. of Boston, Mass., 20 from Providence, R. I., 15 from Taunton, Mass., 13 from New Bedford, Mass., and 18 from Newport, R. I., being central to them all and connected with each by railway. It has a safe and commodious harbor at the head of deep-water navigation.

Quequechan river furnishes abundant water-power, as it here falls 127 feet in less than half a mile. The volume of water is so uniform that mills are built directly across the stream without danger from freshets. The industries comprise immense granite quarries, 2 large calico print-works, a large bleachery, a spool and bobbin factory, etc., but the city is chiefly noted as the most important cotton-manufacturing center in the U. S. In 1900 there were 83 mills, keeping in motion 3,029,586 spindles and about 74,000 looms.

Public Institutions, etc.—The city contains 65 churches (51 Protestant and 14 Roman Catholic), a children's home, a public library with over 60,000 volumes, and excellent schools, comprising, besides those of lower grade, 14 grammar schools. There are 3 kindergarten schools and a normal-training school. The B. M. C. Durfee High School occupies an entire square and cost $750,000, and was a memorial gift to the city from Mary B. Young in honor of her son. The city also has a textile school with buildings valued at $150,000. There are 7 national banks with a capital of $2,150,000. There are 3 large orphanages and 2 large hospitals, sustained largely by private contributions. The city has electric street railways, an excellent system of sewers, several public parks, and a system of water-works, completed at a cost of $1,500,000, bringing the water from Watuppa Lake, a beautiful sheet of water 10 miles long on the eastern side of the city. Fall River was first settled in 1659, became a town in 1803, and was incorporated a city in 1854. Pop. (1880) 48,961; (1890) 74,398; (1900) 104,863. J. J. Manning.

Falls City: city; capital of Richardson co., Neb. (for location of county, see map of Nebraska, ref. 11–H); on two railways; 9 miles W. of the Missouri river; in the Great Nemaha valley. It has excellent flouring-mills, broom-factory, pork-packing house, foundry, canning-factory, windmill-factory, steam elevators, a fine system of water-works, etc. Pop. (1880) 1,583; (1890) 2,102; (1900) 3,022. Editor of "Journal."

Falls of Montmorency: See Montmorency, Falls of.

Falmouth, făl′mŭth: seaport of Cornwall, England; on a branch of the estuary of the Fal, which here forms one of the best harbors in England; 5 by 1 to 2 miles in extent, 12 to 18 fathoms deep, and capable of sheltering 500 vessels at once (see map of England, ref. 15–C). It is a rendezvous for fleets and mail-packets. The entrance is defended by Pendennis and St. Mawes castles. Tin, copper, fuel, and pilchards are exported. Pop. (1891) 4,273.

Falmouth: town; capital of Pendleton co., Ky. (for location of county, see map of Kentucky, ref. 2–I); on the Louisville and Nashville Railroad; 40 miles S. by E. of Cincinnati, O., and on Licking river at the mouth of the South Licking. It has 7 churches, a large free school and academy, a woolen-mill, sawmill, 2 flouring mills, distillery, creamery, and canning-factory. Agriculture is the chief industry, and the place is a trading-point for the White Burley tobacco district. Pop. (1880) 967; (1890) 1,146; (1900) 1,134. Editor of "Guide."

Falmouth: township; Barnstable co., Mass. (for location, see map of Massachusetts, ref. 5–K); on Cape Cod Div. of N. Y., N. H. and H. R. R., at the extreme west end of Cape Cod; on the shores of Buzzard's Bay and Vineyard Sound. It has a spacious harbor at Wood's Holl, which is safe, never freezes, and is of sufficient depth for the largest ships or steamers. It is noted as a watering-place, and Falmouth Heights has a wide reputation as a seaside resort. Pop. (1880) 2,422; (1890) 2,567; (1900) 3,500.

Editor of "Cape Cod Independent."

False Bay: an inlet on the east side of the mountainous district of South Africa, which terminates in the Cape of Good Hope. As it is sheltered from the northwest monsoon, to which the harbor of Cape Town is exposed, it receives periodically all trading-vessels from Cape Town for temporary protection, and it is the permanent station of the naval force of Cape Colony.

False Decretals: See DECRETALS, FALSE.

False Imprisonment: an unlawful deprivation of personal liberty. To constitute this offense it is not necessary that there should be an actual incarceration of the person, or that any actual force should be employed in procuring the wrongful restraint. An unwarrantable detention in a private apartment, or even in a public highway, is sufficient, and there need be no other exercise of power than a mere command or direction to submit to arrest, provided it is accompanied with such a display of authority, or such threats of compulsion, or exhibition of means to procure compliance, as naturally lead the person accosted to believe that he is submitting to legal authority, or that he will be forced to yield if he attempts resistance. It is enough that one's voluntary control and direction of his own movements is wrongfully interfered with. False imprisonment usually occurs from the unjustifiable exercise of pretended legal authority, as by arresting without process when process is known to be necessary, or when there is a mistaken assumption that a case is one in which no process is required to sanction an arrest. For instance, a constable or other peace-officer has power to arrest without warrant if he have reasonable ground of suspicion that a felony has been committed and that the person whom he seeks to detain is the offender. In like manner a private individual needs no legal process to justify him in taking into custody the supposed perpetrator of a felony whose guilt is reasonably presumable. A private person's privilege in this respect, however, is more restricted than that of a constable, for mere suspicion that the offense has been committed is not enough, but it must be shown to have actually occurred, even though the party suspected be in fact innocent. Furthermore, any person, whether he be an officer or not, in whose presence a breach of the peace is committed, may detain the wrongdoer and deliver him to the proper legal authorities for punishment. But whenever the right of arrest without warrant is exercised, a just occasion must be shown to exist by the entire correspondence of the circumstances of the case with those requirements which alone afford a sufficient cause for detention without process, or the person making the arrest will be guilty of false imprisonment. In all other grades of offense legal process is necessary to justify an arrest, and without it any restraint or detention of a person is unlawful. So an arrest is invalid and wrongful, even if made under color of process, if the process be void from some irregularity or defect, or if the arrest be made on an unlawful occasion, as on Sunday or a legal holiday upon civil process merely. All who are engaged in a wrongful interference with a person's liberty, either as principals or instigators, or those who are indirectly its cause, as by suing out illegal process, knowing it to be unjustifiable, are guilty of an unlawful arrest, and equally punishable.

The remedies for false imprisonment are adapted to secure either a restoration of the person confined to liberty, as by writ of HABEAS CORPUS (*q. v.*), or the punishment of the party who is chargeable with the wrongful confinement, as by a civil action for damages or a criminal indictment. The jealous care and watchfulness with which the right of personal liberty is protected at common law, and the numerous safeguards which have been provided to secure its unhampered exercise, are abundantly indicated by this variety of remedies, and by the strict rules which confine the power of arrest without process within narrow limits, only permitting its exercise when offenses of a particularly criminal character are to be punished, and when any requirement of delay for the purpose of obtaining a warrant would be attended with danger to the welfare of the community. The high degree of civil liberty which English-speaking peoples have developed and maintained so sedulously is an outgrowth of that sense of personal independence and individuality of which the law of false imprisonment furnishes so ample and noteworthy an exemplification. See the article IMPRISONMENT.

False Pretenses: See CHEAT.

Falster, faal'ster: Danish island in the Baltic; separated from Seeland, Möen, and Laaland by very narrow straits. It is very low, entirely flat, and somewhat unhealthful, but it is very fruitful and well cultivated. It has an area of 183 sq. miles, and a population of 35,000. The principal town is Nykjöbing, on the Guldborgsund.

Falster, CHRISTIAN: Danish poet and classical scholar; b. Jan. 1, 1690. He spent his life as rector of the school at Ribe, refusing two calls to the university. As a poet he is chiefly distinguished for his satires, which were published anonymously at various times between 1720 and 1740. His philological activity was mainly in the line of Latin. He made collections for an extensive work on Aulus Gellius, which was never published. His best-known contribution to scholarship, a collection of papers under the title of *Amœnitates Philologicæ*, was published at Amsterdam in 3 vols. (1729–32). D. Oct. 24, 1752. G. L. K.

Falun, faa'loon, or **Fahlun**: town of Sweden; at Lake Runn; 120 miles N. W. of Stockholm (see map of Norway and Sweden, ref. 10–F). It is famous for its copper mines, which gave Gustavus Adolphus occasion to call it "the treasury of Sweden," as at that time the mines yielded 3,000 tons annually. The amount yielded yearly has decreased to 400 tons, however. Pop. (1891) 8,010.

Famagos'ta, or **Famagusta**: city on the eastern coast of Cyprus (see map of Turkey, ref. 7–G). From the twelfth to the eighteenth century, while Cyprus was under the Venetian rule, Famagosta was one of the principal commercial cities of the Levant, but now its defenses, warehouses, palaces, and churches are in ruins, and its harbor is choked up by sand. Corn and pomegranates are exported. Pop. (1891) 3,367.

Familiars [liter., those belonging to the family, i. e. to the official family of the inquisitor. From Lat. *familia'ris*, deriv. of *fami'lia*, family]: See INQUISITION.

Familiar Spirits [*familiar* is viâ Fr. from Lat. *famili-a'ris*, familiar, domestic, deriv. of *fami'lia*, family, household]: demons supposed to be in attendance upon fortune-tellers, necromancers, and the like. The original Hebrew word (אוב; plu. אובות) which is rendered in the English version *familiar spirit* or *spirits* occurs in the Bible at least fifteen times (Lev. xix. 31; xx. 6, 27; Deut. xviii. 11; 1 Sam. xxviii. 3, 7, 8, 9; 2 Kings xxi. 6; xxiii. 24; 1 Chron. x. 13; 2 Chron. xxxiii. 6; Isa. viii. 19; xix. 3; xxix. 4). The primary meaning of אובות, *oboth*, is *leathern bottles*, suggesting the idea of *inflation* by the familiar spirits, with some reference, perhaps, to the tricks of ventriloquism. The Hebrew word has also two secondary senses. In some of the passages referred to above it denotes the persons who "have" or employ familiar spirits; in others, it denotes the spirits themselves. For example, persons are meant in Lev. xix. 31, and spirits in Deut. xviii. 11. Nothing is said in the Bible to justify the inference that such spirits were actually in attendance upon fortune-tellers and necromancers. The witch of Endor (1 Sam. xxviii.) was generally *supposed* to have a familiar spirit. But the coming of Samuel in answer to her incantations appears to have been more than the witch herself was expecting.

Familists, or **Family of Love**: an English mystic sect; founded in Holland by Henry Nicholas, a native of Westphalia, and originally an Anabaptist, and finally transferred to England near the middle of the sixteenth century. They taught that religion consists wholly in love, independently of any form of truth held and believed. Through love man could become absolutely absorbed in and identified with God in a subjective sense; that God regards not the outward actions, but only the heart; that to the pure all things are pure, even things forbidden. Nicholas, as the apostle of this "service of love," claimed, it is said, superiority over Christ, on the ground that Moses only preached *hope*, Christ *faith*, but he preached *love*. Much misrepresentation of their confession of faith (given in Strype's *Annals*, ii. 57) brought out an *Apology* in 1575, in which they sought to identify themselves with evangelical Christianity. In 1580 Queen Elizabeth instituted an investigation into their practices, and in consequence they were dispersed and their books publicly burned. They continued to flourish, however, for another century, and in 1604 petitioned King James for permission to publicly clear themselves of the charges preferred against them. This request was denied them, because they were known to have been guilty of grossly immoral practices. (Baxter, *Autobiography*, p. 77.) See a curious book by J. R. (John Rogers) entitled *The Displaying of an Horrible Sect naming themselves the Family of Love* (London, 1579), and

Knewstub, *Confutation of Monstrous and Horrible Heresies taught by H. N., etc.* (London, 1579); Mosheim, *Ecclesiastical History*, ch. xvi., § iii., p. xii., § 25: Collier, *Ecclesiastical History of England*, vi. 609; vii. 311; Hardwick, *History of the Reformation*, ch. v.; Carrière, *Philos. Weltanschauung d. Reformationzeit* (Stuttgart, 1847); R. Barclay, *The Inner Life of the Religious Societies of the Commonwealth* (2d ed. London, 1877).

Family [Fr. *famille* < Lat. *familia*, household]: etymologically the servants or slaves of a household; extended to designate the group of persons, including wife, children, and servants, who in Roman law were under the *patria potestas*. The word acquired biological, ethnological, and legal meanings that are often confused. The traditional belief, definitely formulated by Aristotle in the *Politics*, that the patriarchal family was the primitive social group, which grew, by the multiplication of descendants, into the tribe and the state, has been challenged by modern ethnographers. Bachofen, Morgan, McLennan, Post, etc., find many evidences, including a descent of names and property in the female line, that mankind lived originally in unorganized hordes or bands, within which definite family relationships were slowly evolved. The patriarchal theory has been defended by Sir Henry Sumner Maine, and Starcke and Westermarck hold that a definite paternal family has always existed in human communities. In Europe and the U. S. the stability of the family is threatened by the increase of divorce. See SOCIOLOGY. FRANKLIN H. GIDDINGS.

Family: in zoölogy, a group of animals intermediate between the genus and order; it is based on structural features of a more general character than the genus, while the limits are determined by the range and extent of the differential characters which exist between the typical form and the next allied: a family may therefore be monotypic (i. e. limited to a single known species), or exceedingly polymorphic (i. e. embracing thousands of species). Examples of family groups are found among mammals in the cat-like animals (*Felidæ*), the dog-like animals (*Canidæ*), and the bear-like animals (*Ursidæ*), in the order of *Carnivora*; in the horses and asses (*Equidæ*), the rhinoceroses (*Rhinocerotidæ*), the tapirs (*Tapiridæ*), and the hollow-horned ruminants—i. e. cattle, sheep, goats, and antelopes (*Bovidæ*)—in the order of *Ungulates*, and in man (*Hominidæ*) in the order of *Primates*. Inasmuch as a distinctive similarity of form is associated with the structural characters which distinguish most of these and many other families, especially of mammals, the group has been defined, by Prof. Agassiz, as the embodiment of form determined by structure. This definition, however, entirely fails in many, and even perhaps most, cases; for example, in the *Unionidæ* some forms are higher than long, while others are extremely elongated; and in the *Primates* there is a greater difference in form between some monkeys of one family than there is between others of different families. Families are therefore distinguished on account of certain differences in structure which may or may not be correlated with corresponding modifications of form. No exact criterion can be given, discrimination being a matter of judgment.

The term *family* was originally introduced by French naturalists as the vernacular equivalent of the Latin *ordo*, and in this sense it is still used by botanists—e. g. by Dr. Asa Gray, who combined certain forms in groups, for which he employed the word *order* as the scientific term, and *family* as the popular; thus, *Order 1. Ranunculaceæ* (*crow-foot family*). By Lamarck and Latreille, however, the two terms were restricted in meaning, the word *order* being retained in the sense in which it was employed by Linnæus, while the word *family* was re-established for a section of the order. Later (in 1811), William Kirby (*Trans. Linn. Soc.*, London, xi., p. 88) proposed that all families should have the patronymic termination *-idæ*; and this was gradually adopted, and now it is almost universally employed by zoölogists. Although, strictly speaking, the use of this termination may not always be in exact accordance with grammatical purity, its great convenience as a uniform indicator of the taxonomic value of the group outweighs the objections, and has insured its currency.

THEODORE GILL.

Family of Love: See FAMILISTS.

Famine [M. Eng. *famine*, from O. Fr. *famine* > Fr. *famine* < Low Lat. **fami'na*, deriv. of *fa'mes*, hunger]: an extreme dearth of food, resulting in death by starvation and disease to large numbers of people. The U. S. has never known a famine, in the proper sense of the word. Droughts, long-protracted terms of cold weather, plant-diseases, grasshoppers, mice, etc., have now and then caused dearths, but even these have generally been confined within narrow limits. In Europe also famines belong to the past, in consequence of the change which has taken place in the cultivation of the soil and the diet of the great mass of the population since the latter part of the eighteenth century. Since the general introduction of the potato a failure of the cereal crop does not mean immediate want of breadstuffs. By means of the steamship, the railway, the telegraph, etc., the movement of both bread and meat can be regulated at will. A famine in Western and Central Europe is impossible.

In Asia the situation is quite different. There nature has only partially provided for a speedy communication with the interior by means of navigable rivers. Canals and roads are rare. The aversion to railways and the great difficulties in building them have been successfully overcome only in India and Japan. In the interior and in the northern parts immense regions of deserts or steppes occur, in which good crops can be raised only along the rivers and by means of irrigation. In the southern parts, where the vegetation is generally luxuriant, good crops depend upon rain in the right season; and there the climate and religious prejudices have engendered many peculiar customs; millions of people eat no meat, others eat only one kind of cereals—for instance, rice, etc. Add to this the enormous density of the population in many districts—a thousand to a square mile in Howrah, near Calcutta, and about half that number in the Chinese province of Kiang-su—and it will be easily understood that a failure of the crops must cause great distress. As every means of making up for the dearth of one region by the abundance of another is wanting, famines, with all their horrors, are of frequent occurrence. India, Persia, the northern provinces of China, and Turkish Armenia have suffered from them, and Japan has escaped only by prohibiting all exportation of rice.

In 1873 the rice crop of the district of Behar, in Northwestern Bengal, yielded only a quarter of the average harvest, and as 15,000,000 people were dependent on this crop for sustenance, the Government was obliged to make purchases of rice, chiefly in Farther India, and provide means of conveying it to the distressed districts, including the building of a railway 45 miles long. For a long time 3,900,000 persons received daily support—650,000 in the form of alms, 1,800,000 in the form of pay for work, and the rest in the form of loans. This relief was continued from Oct., 1873, till Dec., 1874; the expenses of the Government amounted to £6,500,000, while private subscriptions yielded £280,000 more, large donations having been sent from all parts of the British empire. Thus, through the prompt action of the Government, a great famine, in which the people of themselves would have been helpless, was averted, with a record of only twenty-five deaths from actual hunger.

While the Indian authorities were discussing the most effective means of preventing a repetition of this calamity, a new famine, caused by insufficient rainfall, began to threaten the Deccan, in Southern India. The crops yielded only one-sixteenth the average harvest, and the threatened district had a population of about 8,000,000. The Government left the supply of food to private speculation, and confined itself to giving alms and providing work. In Jan., 1877, support in the form of pay for labor in public work was given to 1,500,000 persons, and the public debt of the country was increased on account of the famine by £5,000,000.

The famine in Persia from 1870 to 1873 extended over the whole country. More than 1,500,000 people died. To add to the general distress, the Turcomans of the desert took advantage of the calamity, invaded the country several times, and carried away more than 20,000 Persians to the slave-markets of Khiva and Bokhara.

The interior provinces of Asia Minor—for instance, Angora and Konieh or Iconium, situated immediately to the S. of Angora—suffered severely from 1873 to 1875. On account of the drought, 2,500,000 oxen and horses and 528,000 goats died in Angora; the number of persons who starved to death varied in the different provinces from 6,000 to 20,000.

The European country which has suffered from famine in modern times is Russia. There was a severe general famine in 1833; one in the central provinces in 1840; in the western provinces in 1844–46; in the south in 1867–68; in the Volga region in 1872; in the central provinces in 1880; and throughout the center and east in 1891–92. The famines of 1833 and 1891–92 have been the worst. The latter was due to the failure of the rye crop on account of drought, to the general poverty, and to the insufficient means of transportation to the most afflicted districts. It was general in thirteen provinces and partial in five others, the population affected by it being estimated at 27,000,000. It was signalized by more efforts at relief than the earlier, and the contributions from the U. S. to this end were large and generous. But the difficulty lies too deep for superficial measures of relief. It is found in the inferior economic organization of Russia. The deficiency in the harvest of 1891 was only 20 per cent.—about the same as the deficiency in the U. S. wheat crop of 1885. Yet there was no famine in the U. S.; partly because of the free communication between different parts of the country, partly because of forethought, which had accumulated supplies from past years. A comparison of these two cases shows better than anything else the reason why famine disappears with advancing civilization.

Deaths in times of famine occur quite as often from famine types of disease as from starvation. Thus relapsing fever is so characteristic of famines as to be called famine fever. Typhus and cholera follow on the weakness that results from insufficient food, and where drought is the main cause, the concentration of bad elements in the water engenders other destructive diseases.

The following table shows the most noted famines mentioned in history:

B. C.
1708–01. Egypt.
436. Rome.
A. D.
42. Egypt.
262. Rome.
272. Britain.
306. Scotland.
310. England.
370. Phrygia.
450. Italy.
739. Britain.
823. The same.
954–58. The same.
1005. England.
1016. Europe, generally.
1051. Mexico.
1052–60. Ghor, India.
1064–72. Egypt.
1069. England, north.
1087. England.
1193–95. England and France.
1251. England.
1314. Silesia, Poland, and Lithuania.
1315. England.
1335. England.
1344. Deccan, India.
1347. Italy.
1353. England and France.
1438. England.
1491. Ireland.
1565. British isles, generally.
1586–89. Ireland.
1600. Russia.
A. D.
1631. India, Asia generally.
1693. France.
1711. Carniola, Austria-Hungary, several years.
1748. British isles, generally.
1769–71. Bengal.
1775. Cape de Verde.
1781–83. Carnatic and Madras.
1772–84. Northwest Provinces, India.
1789. France.
1790–91. India.
1795. England.
1801. British isles, generally.
1813. Drontheim, Norway.
1814, 1816, 1822, 1831, and 1846. Ireland.
1837–38. India, northwest.
1860–61. The same.
1865–66. Bengal and Orissa.
1868–69. Rajputana, India, northwest.
1870–73. Persia.
1873–74. Bengal.
1873–75. Angora and Konieh, Asia Minor.
1877. Bombay, etc., India.
1877–79. Northern China.
1879. Kashmir.
1880. Asia Minor.
1888–89. Northern China.
1891–92. Russia.
1896–97. India.
1900. India.

Revised by A. T. Hadley.

Fanar′iots: See Phanariots.

Fancinlli, Francesco: See the Appendix.

Fancy [M. Eng. *fantasy*, from O. Fr. *fantasie*, *fantaisie* < Lat. *phanta′sia* = Gr. φαντασία, appearance, imagination]: a term used sometimes as synonymous with Imagination (*q. v.*); but better practice appears to conform more or less closely to that of Dugald Stewart, who says: "The office of this power is to collect materials for the imagination; and therefore the latter power presupposes the former, while the former does not presuppose the latter."

Fandan′go: a national dance of Spain and Spanish America, usually in 3–4 or 6–8 time. It is thought by some to have been introduced by African slaves into the colonies, and thence carried to Spain. It is very popular, and is danced generally to the guitar and the castanets.

Faneuil, făn′el or fŭn′el, **Hall**: a building in Dock Square, Boston, Mass.; built in 1742 by Peter Faneuil, a merchant of the city (b. at New Rochelle, N. Y., 1700; d. in Boston, Mar. 3, 1743), and given to the town. It was burned in 1761, its walls of brick remaining. It was rebuilt in 1763, at the expense of the town. It is called the "Cradle of Liberty," from the fact that the "Sons of Liberty" held many meetings there during the early years of the final struggle of the colonies with the mother country. The British troops, during the occupation of the city, used it as a theater. In 1805 it was made 40 feet wider and one story higher. The hall, which is used for public meetings, is about 80 feet square, and contains several good paintings, including *Webster replying to Hayne.*

Fanino, fa̤ă-nee′nō, or **Fannio**, Faventino: one of the earliest martyrs during the Reformatory period in Italy; a native of Faenza, then in the papal dominions. He was won over to the Protestant cause by the reading of the Scriptures (probably Bruccioli's version, 1532) and of Protestant apologies, and became so enthusiastic for the new religion that he gave himself to proselyting efforts, which came to the ear of the ecclesiastics, and he was imprisoned. Being the head of a family, he was persuaded to recant for the sake of his wife and children. Upon his release, however, he became dejected in mind, and found peace only in the resolve to openly battle for liberty of conscience; and he set out on a tour through the Romagna, preaching everywhere the Reformed religion. He was arrested in 1548 at Bagna Cavallo, and conducted in chains to Ferrara. During his imprisonment he was visited by many distinguished Italians, among them the Princess Lavinia della Rovero and Olympia Morata, who were edified by his instruction and prayers, and took a deep interest in his fate. But his repeated and emphatic refusals to recant caused his condemnation to the stake by Pope Julius III. Fanino was strangled at dawn and his body burned at noon in Sept., 1550. See for interesting details Young, *Life of Paleario*, ii, 111; McCrie, *History of the Reformation in Italy*, pp. 259–261.

Fanning, Col. David: Tory leader in American Revolution; b. in Wake co., N. C., about 1756; became the leader of a band of Tories or loyalists, chiefly of Chatham and Randolph Counties, who during the later years of the war of the Revolution performed in Central North Carolina many daring exploits, tarnished by wholesale cruelty and the desolation of settlements. In 1781 he took the town of Pittsborough, and soon after Hillsborough, then the State capital, carrying off Gov. Burke and his whole suite. He was one of the three persons excluded by act of the North Carolina Legislature from the amnesty proclaimed after the peace; escaped into Florida, traded with the Indians, made his way to New Brunswick, and thence to Digby, Nova Scotia, where he died in 1825. He wrote a curious *Autobiography* (limited eds. Richmond, Va., 1861, New York, 1865).

Fanning, Edmund, LL. D.: b. on Long Island, 1737; graduated at Yale College 1757; settled in Hillsborough, N. C., and became colonel of militia, clerk of the superior court, and a member of the Legislature; by his exactions as recorder of deeds for Orange County provoked the hatred of the people, and in 1771 went to New York with Gov. Tryon, who was his father-in-law. He took part against the people in their struggle for independence of Great Britain, and in 1777 raised and commanded the king's American regiment of foot. In 1779 his property was confiscated. After the war he was appointed councilor and lieutenant-governor of Nova Scotia, and governor of Prince Edward island (1786–1805). He was successively major-general, lieutenant-general, and general in the British army, and received the degree of D. C. L. from Oxford in 1774, and that of LL. D. from both Yale and Dartmouth in 1803. D. in London, Feb. 28, 1818.

Fanning, John Thomas: civil engineer; b. in Norwich, Conn., Dec. 31, 1837. He was educated in the schools of Norwich, and afterward studied architecture and civil engineering. During the civil war he served with the Third Regiment of Connecticut volunteers. From 1862 to 1871 he was acting city engineer of Norwich. From 1872 to 1886 he held a similar position at Manchester, N. H. In 1886 he removed to Minneapolis, Minn., where he has since resided. He has been a consulting engineer of many water-powers, of the drainage commission of the valley of the Red River of the North, and of railway enterprises. He is the author of a *Treatise on Water Supply Engineering* (1877; 10th ed. 1892). He is an ex-president of the American Water-works Association.

Fanning Islands: See the Appendix.

Fanning-machine, or **Fanning-mill**: an agricultural implement for winnowing grain, operated by machinery or by the hand. The principal feature is a rotary fan. As the grain passes through the sieve in which it is agitated, the strong current of wind produced by the fan cleanses it thoroughly from chaff. Anciently, the wind was the agent chiefly employed for separating chaff and dirt from grain; and the *mys-*

tica vannus Iacchi, like the winnowing fan of the Bible, seems to have been at first a mere shovel for throwing up the grain and exposing it to the action of the wind. A machine for winnowing grain was invented in Scotland in 1737 by Andrew Rodger, a farmer of Roxburghshire, but though it in every respect far excelled the old method of winnowing by throwing the grain across the threshing-floor, its introduction met with great opposition, because the raising of wind by human art was believed to be an impious act. There have been many improved forms invented, especially in the U. S.

Fan'nius Stra'bo, Gaius: son-in-law of Lælius; introduced by Cicero as one of the speakers in his works *De Amicitia* and *De Republica*; served in the Third Punic war under Scipio Africanus (B. C. 149–146); was distinguished as an orator, and was one of the earliest Roman historians who wrote in Latin. His *History* treated of contemporary events, and the eighth book is referred to, though the extent is not known. An epitome of it by M. Brutus is mentioned by Cicero. The few fragments remaining are collected in H. Peter, *Hist. Rom. Fragm.*, pp. 87–89. (See Gerlach, *Geschichtschreiber der Römer*, pp. 70–71, and Hirschfeld, *Die Annales des C. Fannius, Wiener Studien*, vi. 127.) This Fannius is now identified with C. Fannius Strabo, who was consul B. C. 122, and from whose speech on the allies and Latins, directed against Gracchus (praised as good and noble by Cicero), certain fragments are preserved. These are given by Meyer, *Orat. Rom. Fragm.*, pp. 199–200.

Revised by M. Warren.

Fano, faa'nō: seaport of Central Italy; province of the Marches; on the shore of the Adriatic, lat. 43° 51′ N., lon. 13° 1′ E.; 30 miles N. W. of Ancona (see map of Italy, ref. 4–E.) It is a well-built and beautifully situated town, containing a cathedral with paintings by Domenichino and Guido, and the remains of a triumphal arch of white marble erected in honor of Augustus. There is a large trade in corn, oil, and silk goods. Pop. 22,000.

Fans [Ang.-Sax. *fánn*, from Lat. *vannus*, which is akin to *wind*]: implements used to agitate the air for coolness, and apparently in use from the remotest times with all people living in hot or warm climates. China, however, is generally called the fatherland of the fan, and there and in Japan it is as indispensable to a gentleman as his boots. It is used in different ways, even as a newspaper, since on important occasions news, libels, and political caricatures are transmitted on it. The common palm-leaf fan is generally supposed to be the oldest form of this implement, as it is still by far the best for simple utility. It is manufactured in immense quantities in China, especially at Canton and Nankin, where also fans of great elegance are produced from bamboo, palm leaf, silk, sandal-wood, tortoise-shell, and ivory. A very singular style of Chinese fan consists of a round paper disk mounted in a split handle on a pivot like a wheel. When not in use it is turned around and folded up, so as to make a straight stick. In Persia, Egypt, Greece, and Rome fans were known at a very early period, and in each country they attained great elegance. The Egyptians carried a peculiar fan made of a bird's wing extended, such as are beautifully manufactured by the Chippeway Indians. From a passage in Euripides it appears that Greek fans were round and made of feathers, and when the peacock was introduced into Greece (about 500 B. C.) the people began to use its plumes for fans. In Herculaneum there is a fresco representing a youth holding a peacock fan. The Roman fan for ladies was often made of thin tablets of perfumed wood; and as branches of myrtle, acacia, and palm were the first fans or materials for them, these shapes were preserved in imitations for centuries. A fan with a wooden handle, and a *feuille* provided with a picture of a love-affair or a view of a city, with a corresponding inscription, was much in use in Italy during the Middle Ages. In a work of costumes which appeared at Venice in 1664, containing plates of several hundred dresses, especially those worn in Lombardy from the eleventh century, women often hold fans, some of them of very eccentric shapes. The *tuft*-fan of peacock's feathers was set on an ivory handle adorned with gems, and one like this, but with a horse's tail, appears on the sculptures of Persepolis. In the list of articles in Queen Elizabeth's wardrobe twenty-seven fans are enumerated, one of which cost £40, and about 1660 the manufacture was quite extensive in England, as appears from a petition of the fan-makers, who complained that, 550,000 fans having lately been brought over, "great numbers of poor people, continually employed in the work, must perish unless a stop be put to the importation." In 1660 a protective duty of 40*s*. per dozen was imposed on fans, and the importation of all painted fans was prohibited. The folding fan was introduced in France by Catharine de Medicis, and under Louis XIV. the manufacture became a great industry. Those who exercised it formed a corporation, established in 1673, and four years of apprenticeship were required, though the masters who made this regulation wisely set it aside in favor of their own sons or of any man who should marry their daughters or widows. One of the most original patterns of French fans was the so-called Pompadour, consisting of brins without *feuilles*, and forming, when opened, a beautiful oval. During the Revolution fans went out of fashion, but in the nineteenth century the manufacture revived and has become very prosperous. Large quantities of costly fans are produced in Paris, made of what is called chicken skin (a very thin yet tough preparation of kid skin), satin, gauze, tulle, crape, or parchment, and provided with beautiful pictures by well-known artists, priced at from £50 to £130. Large numbers of these fans are exported to Spain, where the fan is as essential an article as in China or Japan. The native Spanish product, however, is rather coarse and ungainly, and, although Spain has laid a heavy duty on French fans, the Spanish workmen are yet not able to compete with the French. A fine exhibition of fans was held at the South Kensington Museum, London, in 1870. The Empress of France, who had been instrumental in developing this branch of industry, as of all kinds of luxury in dress, sent to it all her finest fans, thirty-four in number. See works by Blondel (Paris, 1875); Uzanne (Paris, 1881; Eng. trans. London, 1883); and Lady Charlotte Schreiber (2 vols., London, 1889–91).

Charles G. Leland.
Revised by F. H. Groome.

Fans, otherwise called **Fanwe, Panwe**, and **Osheba**: a cannibal race found upon the Gaboon river and to the northeast over an extensive area in equatorial Africa. They are coffee-colored, have rather thin lips, and are slight of frame. They are cannibals for ceremonial purposes, use poisoned arrows and the crossbow, and are fast becoming the dominant people of that region, where they first appeared about 1842.

Fanshawe, or **Fanshaw**, Sir Richard, D. C. L.: diplomatist and translator; b. at Ware, Hertfordshire, England, 1608; studied at Cambridge; and was minister resident at the court of Spain under King Charles I. of England. He was a royalist, and at the battle of Worcester, 1651, was taken prisoner and kept captive for years. He was privy councilor of Ireland 1661; the same year ambassador to Portugal, and negotiator of the marriage between Charles II. and the Princess Catharine. In 1664 was ambassador to Spain. D. in Madrid, June 16, 1666. His translations were Guarino's *Pastor Fido*, *The Lusiad* of Camoens, etc.

Fantail: See Pigeon.

Fanta'sia [Ital., fancy < Lat. *phanta'sia* = Gr. φαντασία. See Fancy]: in music, a species of composition nearly identical with the cappriccio, in which writers express their thoughts with the highest freedom compatible with an observance of the fundamental laws of harmony. Originally, the fantasia was probably nothing more than simple improvisation—a transient, unstudied, and unwritten effusion of the performer's fancy. But as extempore playing naturally leads to the recording of the ideas, themes, and general course of thought pursued in any successful effort, the transition was easy to the writing, at leisure, of compositions resembling improvisations in peculiarities of movement, form, modulation, expression, and harmony. In many of these compositions writers give free play to the impulses of a luxurious fancy, regardless of method and design, but still preserving a certain continuity of outline amid much that is wild, rugged, and abrupt. The term "fantasia," however, is now often given to compositions which are nearly regular in form and harmony.

Revised by Dudley Buck.

Fan'ti, or **Fantee**: a tribe, and the country it inhabits in Western Africa; on the Gold Coast. The country consists of a small strip of land extending along the Atlantic from Accra on the E. to Cape Coast Castle on the W., and separated N. from the country of the Ashantees by a belt of impenetrable forests crossed only by a few narrow and intricate paths. But this strip of land is very fertile, densely peopled, and rich in gold-dust. The inhabitants belong to the same family and speak nearly the same language as the Ashantees, though they are inferior to them both in skill and vigor. They succeeded, however, in defending their independence. They started an individual civilization. They built large cities, such as Yankumasi, Abrah, Annamabu, etc., and they began trading and manufacturing. But early in the nineteenth century they came in contact with the British, who built a fort and established a commercial station at Cape Coast Castle. Their labor became subservient to English enterprise and speculation. Their political organization became weakened and almost dissolved under English influence and authority. Their civilization faded away, and they became a prey for the Ashantees, who in their turn were conquered by the British. See ASHANTEE.

Fantin-Latour, fäaṅ'tăṅ'läa'toor', HENRI: portrait and genre painter; b. at Grenoble, France, Jan. 14, 1836. Pupil of Lecocq de Boisbaudran; medal, Salon, 1870; second-class medal, Salon, 1875; Legion of Honor 1879. A talented, conscientious painter whose work has not attracted wide attention until recent years; his portraits are notable for their air of truth and quiet, reserved style. *Homage to Delacroix* (1864) is one of his celebrated portrait groups. Studio in Paris. W. A. C.

Fantoccini, făn-to-chee'nē: See MARIONETTES.

Fan-tracery: the tracery-like system of ribs forming panels in English FAN-VAULTING (*q. v.*).

Fan-vaulting: a species of vaulting peculiar to the English Gothic of the fifteenth century; so named from the fan-like radiation of groups of ribs from the caps of the vaulting-shafts. Each group forms a kind of inverted semicone with curved sides; the bases of these semi-cones, meeting at points along the ridge of the vault, inclose between them horizontal lozenge-shaped panels. Cusps and foils adorn the panels left between the ribs. Among the finest examples are the chapels of King's College, Cambridge; St. George at Windsor; and Henry VII. at Westminster Abbey. See illustration under ARCHITECTURE (Fig. 42).

Revised by A. D. F. HAMLIN.

Farad [from MICHAEL FARADAY (*q. v.*) the electrician, in recognition of his classical researches in static electricity. For the method of naming, see OHM, AMPÈRE, VOLT, etc.]: the practical unit of electrostatic capacity. It is the capacity of a condenser such that the introduction of a charge of one coulomb of electricity will produce a difference of potential of one volt between the coatings. A *farad* is one-thousand-millionth of the absolute unit of capacity (c. g. s. system). A *micro-farad*, a lesser unit, the size of which renders it of much more general application than the farad, is one-millionth of the latter. The capacity of the ordinary condenser is a micro-farad or a simple multiple of it.

E. L. NICHOLS.

Far'aday, MICHAEL, D. C. L., F. R. S.: scientist; b. at Stoke Newington, near London, Sept. 22, 1791. His father was a blacksmith, and his own education he describes as being "of the most ordinary description, consisting of little more than the rudiments of reading, writing, and arithmetic." In 1804 he became an errand-boy to a bookbinder, and in 1805 he was taken as an apprentice. He read many of the books he bound, especially Mrs. Marcet's *Conversations on Chemistry* and the articles on electricity in the *Encyclopædia Britannica*. He also made electrical experiments, and went occasionally to evening lectures on natural philosophy, and in order to draw the apparatus employed he took lessons in perspective. After his apprenticeship he worked for a time as a journeyman bookbinder, and as amanuensis for Sir Humphry Davy, who had become interested in him.

On Mar. 18, 1813, Davy reported to the managers of the Royal Institution his engagement of Faraday at weekly wages. Faraday subsequently traveled with Davy on the Continent, returning to the institution in 1815. Not long after he became connected with the City Philosophical Society, where he sometimes lectured.

Three years after his appointment in the Royal Institution he made his first published contribution to science: it was an analysis of some caustic lime from Tuscany. Both skill and insight are revealed by a short paper on sounding flames published in 1818. Other smaller contributions followed. In 1820 a chemical paper opened the long series with which Faraday subsequently enriched the *Philosophical Transactions*.

Oersted's discovery in 1820 directed all minds to the interaction of magnetism and electricity. In 1821 Faraday wrote *A History of the Progress of Electro-Magnetism*, and, thus prepared, he succeeded on Christmas morning, 1821, in making a magnetic needle rotate round a wire carrying an electric current. To Faraday's intense annoyance it was whispered that he had plagiarized the experiment from Wollaston, but he completely cleared himself of this charge. In 1823, aided by suggestions from Davy, he liquefied chlorine and other gases. In 1824 Faraday was elected a fellow of the Royal Society. In 1825 and 1826 he published chemical papers in the *Philosophical Transactions*. In one of these he announced the discovery of benzol, which afterward became the basis of aniline dyes. From 1825 to 1829, in conjunction with Herschel, he tried to improve the manufacture of glass for optical purposes. Practically considered, this investigation was a failure, but the "heavy glass" they produced led afterward to two of Faraday's greatest discoveries. In 1827 he succeeded to Davy's chair of Chemistry in the Royal Institution.

Disciplined and strengthened by his previous work, Faraday, in 1831, made his great discovery of magneto-electric induction, opening thereby a vast and novel electrical domain. Enigmas which had previously challenged and defeated the efforts of the greatest men ceased to be enigmas. The magnetism of rotation, for example, discovered by Arago and experimented on by Babbage and Herschel, was shown to be due to a special manifestation of Faraday's induced currents. In the paper here referred to he for the first time calls the "magnetic curves" formed when iron filings are strewn around a magnet "lines of magnetic force." All his subsequent researches upon magnetism were made with reference to those lines. They enabled him to play like a magician with the magnetic force, guiding him securely through mazes of phenomena which would have been perfectly bewildering without their aid. The spark of the *extra current* had been noticed by Prof. Joseph Henry, and independently by Mr. William Jenkin. Faraday at once brought this observation under the yoke of his discovery, proving that the augmented spark was the product of a secondary current evoked by the reaction of the primary upon its own wire.

The desire to refer diverse natural energies to unity of principle is the strongest of the scientific mind, and in 1833 Faraday proved experimentally the "identity of electricities." He then passed on to electric decomposition, both by the machine and the pile, and was led to conclude, though he was almost afraid to publish the conclusion, that the amount of electricity involved in the decomposition of a single grain of water equals that produced by 800,000 discharges of his large Leyden battery. In May, 1833, he published a paper on a *New Law of Electric Conduction*, in which he forcibly showed the influence of the "state of aggregation" on the transmission of the current. This led him to a profound consideration of the subject of electrolysis. Again, in June, 1833, he published a paper on this subject, and in the same year another entitled *On the Power of Metals and other Solids to Induce the Combination of Gaseous Bodies*.

Far more important, however, was the establishment of the doctrine of "definite electro-chemical decomposition." He included in the same circuit water and fused chloride of tin, and found that for every atom of hydrogen and oxygen liberated in the one cell there is an atom of tin liberated in the other. With the indications of his voltameter he compared the decompositions of other substances, both singly and in series, and after submitting his conclusions to numberless tests he finally established the truth, "that under every variety of circumstance the decompositions of the voltaic current are as definite in their character as those chemical combinations which gave birth to the atomic theory."

With regard to the origin of power in the voltaic pile scientific opinion had been divided. Volta found the source of power in the contact of heterogeneous metals, and he proved beyond a doubt that electricity arises from such contact. Faraday's experience had showed him that chemical action was the invariable accompaniment of the current; it had led him to conclude that the one was proportional to the other, and therefore forced upon him the conviction that the "contact theory," as maintained by Volta, was a delusion. The origin of power in the pile he referred to its chemical actions. He thus became the strongest pillar of the "chemical theory," which had been previously enunciated by Fabroni and Wollaston. His researches in frictional electricity occupied him from 1836 to 1838. He entered with keen insight into the subject of conduction and induction, regarding both from a wholly original point of view. One of his principal results was the establishment of the specific inductive capacity of insulators—a subject of supreme importance in connection with submarine cables. As a striking illustration of Faraday's insight, it may be mentioned that as early as 1838 he had virtually foreseen and predicted the retardation produced by the inductive action between the wires of submarine cables and the surrounding sea-water.

Toward the close of 1840 Faraday broke down, and for two years was prohibited from working. He went to Switzerland in 1841, and slowly improved after his return. He knew that polarized light was a most subtle investigator of molecular condition, and he had tried it frequently in investigating the state of electrified bodies. He placed a piece of his heavy glass between the poles of an electro-magnet. Including both magnet and glass between two Nicol prisms, he sent a beam of light through the system. When the prisms were parallel the light was transmitted—when they were crossed the light was cut off. On exciting the magnet in the case of the crossed prisms, the light was instantly transmitted, and one of the prisms had to be turned through an angle depending on the strength of the magnet and the length of glass traversed to again quench the light. The experiment proved that by the act of magnetization "the plane of polarization" is caused to rotate. Faraday proved the direction of the rotation to be determined by the polarity of the magnet, being reversed when the polarity is reversed. He also proved that the voltaic current exercised a similar power. He pointed out the difference between this effect and the rotation of the plane of polarization by quartz and certain other bodies, and entitled his discovery "the magnetization of light."

This was the first reward of Faraday's long and apparently futile inquiry on the manufacture of optical glass. His second reward was the discovery, in 1846, of diamagnetism, the name given to a force of repulsion exerted by a magnet on the great majority of known bodies. He called it diamagnetism because an elongated diamagnetic body acted upon a magnet sets *across* the lines of magnetic force, while a paramagnetic body, like iron, sets parallel to the lines of force. He pushed his inquiries in diamagnetism into the heart of the subject. Faraday's antecedent culture and his notions regarding molecular force are strikingly illustrated by this inquiry and the subsequent one on magnocrystallic action. To these discoveries succeeded his investigations on the magnetism of gases, his elaborate papers on atmospheric magnetism (1851), his speculations on the nature of matter and force, and his researches on "lines of magnetic force, their definite character, and their distribution within a magnet and through space"—inquiries marked by profound insight and illustrated with refined experimental skill. In 1835 Faraday was pensioned. He was throughout life a devout Christian, and was a member of the small body of Christians called Sandemanians. D. at Hampton Court, Aug. 25, 1867. See *Life* by Tyndall (4th ed. 1884) and *Life* by J. H. Gladstone (1892). JOHN TYNDALL.

Faradization: in medicine, the application to the animal frame of induced currents of electricity. The name faradic electricity is applied (1) to the alternating current from any small "magneto-generator" in which currents are induced by the movement of coils of wire in a magnetic field; (2) to the secondary currents of a small induction coil. The primary circuit coil is usually fed from a few cells of primary or storage battery, and variations in the character and strength of the induced currents are obtained either by changing the speed of the interrupter by the use of various secondary coils, different windings, or by adjustment of the iron core of the coil. The term faradic battery is applied to both of the above types of apparatus.

The best methods for making use of faradism in therapeutics were discovered by Dr. Duchenne, a physician of Paris. It is used for two purposes: (*a*) to produce muscular contractions (passive exercise); (*b*) to excite the nerves of sensation. The first object may be attained in two ways—first, by placing both electrodes (ends of insulated conductors armed with sponge, of various shapes) upon the moistened skin covering the muscles to be contracted; or, second, by placing one electrode as above and the other over the nerve-trunk which sends branches to that muscle. To excite the nerves of sensation, a portion of skin should be made dry by means of starch-powder, a wire-brush electrode held upon or drawn lightly over this dry skin, while the other sponge electrode is held (wet) on the integument not far away. The current can be made to reach the internal organs (bladder, uterus, etc.) by means of peculiarly shaped electrodes. The popular use of faradism by holding both electrodes in the hands is worthless.

Revised by E. L. NICHOLS.

Farallo'ne Islands: a group of six small, lofty, and rocky islands of San Francisco co., Cal.; lying in the Pacific Ocean; 30 miles W. by S. of the Golden Gate, or entrance to San Francisco Bay. They are owned by a company, which here collects, for the San Francisco market, the eggs of the gull and the murre, a sea-bird of the auk family. The southeasternmost and largest island (lat. 37° 41′ 49″ N., lon. 122° 59′ 5″ W.) has a lighthouse, with a flashing white light of the first order, 360 feet above the sea. The islands breed great numbers of rabbits, and their coasts abound in sea-lions.

Farce [Fr. *farce*, orig. meaning stuffing, deriv. of *farcir* < Lat. *farcire*, to stuff]: a peculiar kind of comedy in which the characters are without psychological truth and the plot without moral impression. When in a comedy the *dramatis personæ* are not characters representing complete mental organisms, but figures representing only one single feature of the human mind, and when the situations of which the plot consists are formed without any intention of imitating life, but so as to show off this single mental feature in its most extravagant appearance, a high degree of comical effect can be attained; and there is in the principle itself on which the farce rests no reason why its comical effect should not be accompanied with perfect elegance and gracefulness. The farce originated in the Southern European countries from rustic festivities, in which masks and every other description of disguise were used. There are traces of it in the so-called Fabulæ Atellanæ, far back in the days of the old Roman republic, and it is met with now and then during the Dark Ages, until in the sixteenth century it enters the stage, where it led a brilliant life under the name of *commedia dell' arte*, as a kind of improvised drama. Molière introduced it among the arts. Many of his plays are simply farces. But after his time it was utterly neglected, and degenerated into comedy for the mob, and it showed no signs of revival until the middle of the nineteenth century. The present French farce is often indecent, but its mirthfulness can not be denied. It needs only some purification to be brilliant art.

Farcy [corrup. of M. Eng. *farcin* < O. Fr. *farcin*, a disease of horses: Ital. *farcino*, from deriv. of Lat. *farci're*, cram]: the more chronic form of glanders; a disease attacking horses, asses, and mules, and from them transmissible to men. This disease is highly contagious, and thus far generally incurable. Farcy differs from glanders in having a slower course, and in involving the skin and lymph glands, whereas glanders affects particularly the respiratory tract. It is characterized by the formation of tumors involving the glands of the lymphatic system alone (button farcy), the glands and the adjacent areolar tissue (bud farcy), or the lymphatic vessels (farcy pipe), and is followed by fever. Where farcy runs a somewhat rapid course it is generally fatal; while if its course proves very slow a recovery may be looked for, at least in man. Glanders, however, which is the same disease, primarily attacking the nasal mucous membrane instead of the lymphatics, is almost always fatal. The treatment of acute cases is palliative chiefly; that of very chronic ones is expectant, the strength being maintained by nutritious food. In horses the disease is most common in those which are overworked, exposed to the weather, and kept in ill-ventilated stables. Farcied horses should be killed at once, without any attempt at treatment. See GLANDERS. Revised by WILLIAM PEPPER.

Fardel-bound [M. Eng. *fardel*, from O. Fr. *fardel* > Fr. *fardeau*, bundle, burden < Mediæv. Lat. *fardellus*, pest, from Arab. *far'd*]: a disease of sheep and neat cattle, known in its milder form as "loss of cud." The animal refuses to chew the cud, is stupid, feverish, has a dry nose, and sometimes grunts as if in pain. The disease is an irritation or inflammation of the third stomach (*omasum*, manyplies, or fardel), the folds of which are dry and often inflamed. Sometimes this organ is impacted with food. The treatment is gentle purgation, as with Epsom salts, followed by liquid food, such as mashes sweetened with molasses and flavored with a little ginger. As a preventive, avoid the use of coarse and overripe hay. The animal will generally recover within three weeks.

Farel, fāā'rel', Guillaume: the boldest of the French Reformers and father of Swiss Protestantism; b. in a little hamlet near Gap, in Dauphiny, in 1489. His parents, Roman Catholics of noble descent, subjected him to rigid religious training, and intended him for the army. But the boy gave himself to study, and when all opposition seemed fruitless he was suffered (about 1500) to set out for Paris, there to study philosophy, Greek, and Hebrew at the university. The shining light of the Paris school was at that time the brilliant Jacques Lefèvre d'Estaples (Faber Stapulensis), around whom were gathered disciples from every country. Young Farel became one of the most devoted of these. This illustrious connection was, moreover, the means of withdrawing Farel from obscurity and securing him a large circle of acquaintance and a chair in the College of Cardinal le Moine. Farel had accepted the views of his instructor, and was therefore in danger from persecution. In 1521 Lefèvre retreated to Meaux, but Farel remained in the capital, and for a time boldly continued to maintain his cause with professors, priests, students, and citizens, wherever he could do so, in the university and in the city. The doctors of the Sorbonne, however, proved the stronger party, and Farel soon found it expedient to join Lefèvre at Meaux. Here also persecution found them out, and "the heretics of Meaux" were obliged to quit the town. Farel dared to return to Paris, but, finding himself in great danger, retired to Dauphiny. His three brothers became converts, and many adherents were gathering when the authorities, civil and ecclesiastical, combined against him, and he was obliged to quit the vicinity of Gap. He now visited other parts near the foot of the Alps and labored successfully. His life becoming endangered, he crossed over, early in 1524, into Switzerland, where he was warmly welcomed by the Reformers. He tarried for a while at Basel, making his home with the learned Œcolampadius, who was charmed "with the learning, piety, and courage of the young Frenchman." Basel was at this time much exercised by the religious innovations prevalent there, but officially no action had been taken in favor of the Reformed doctrines. Farel published thirteen theses covering the chief points of dispute, and defended them publicly without answer from the Romanists. In consequence the Reformed doctrines became quite popular, and their success might have been established had not Farel fallen into angry dispute with Erasmus, whom he charged with cowardice and named a Balaam, and who in return called him a disturber of the peace and advised the council to expel him. He left Basel in May, 1524, and repaired to Schaffhausen, Zurich, and Constance. On his return to Basel he was ordered to leave the place. He retired to Strassburg, and there enjoyed the companionship of Capito and Bucer until secretly recalled to Basel to be set apart by Œcolampadius for the ministry at Montbéliard. Farel had from the first been rather turbulent. After he was installed as a priest his intemperance in language and conduct soon made him an object of much hatred. He was driven from his parish in the year 1525. After a brief visit to Œcolampadius, Farel joined Capito and Bucer at Strassburg, where he had another meeting with his beloved teacher, the saintly and now aged Lefèvre. In 1527 he went to Aigle, where he taught school, at first under an assumed name (*Ursinus*), but no sooner had he secured a sufficient hold on the people to warrant his safety than he boldly made known his real mission, and when Berne became Protestant (1528) extended his labors throughout its territory. He communicated his zeal to the Switzers, and by 1531 secured the reformation not only of the western cantons, but also "caused the balance to incline in favor of the new doctrines throughout the confederation." Sent to the Waldenses, then in synod in the valley of Angrogna, he returned in 1532 by way of Geneva, which was at this time agitated by great religious strife. Though a stranger, he dared to preach while in the city. In consequence he was driven from the place, and only escaped with his life by the bursting of a gun that was aimed at him. He returned again in the next year and was again expelled. Still undaunted, he returned a third time, and was successful. The new doctrines were now largely heard and accepted. Farel was full of toil, and his triumph came Aug. 27, 1535, when the city council, by special edict, proclaimed Geneva as an adherent to the Reformation. In 1536 his cause was strengthened by a visit from Calvin, who was persuaded by Farel to take up his residence at Geneva. Farel and Calvin henceforth labored unitedly for the good of the Genevese; Calvin, by common consent, assuming the leadership in ecclesiastical organization. These men found an able assistant in Viret. In consequence of their bitter attack on the sensuality which many of the Genevese had fallen subject to under Savoyard rule, and the strict enforcement of ecclesiastical discipline, the Reformers became unpopular, and (Apr., 1538) were expelled from the city. They went together to Berne, Zurich, and Basel, where they separated, Farel going to Neuchâtel, whose Reformed society was then in deplorable disorder. Farel soon restored harmony (1542). He went to Metz to organize a society, but was persecuted, and finally obliged to retire to the neighboring town of Montigny, and afterward to Gorze, where he enjoyed the protection of Count Fürstemberg. Attacks upon his life caused his removal to Strassburg, and ultimately his return to Neuchâtel, where he married, when sixty-nine years old, a young wife, very much to Calvin's disgust. In 1560 he visited his native Dauphiny, and at Gap by his bitterness excited the rabble, who put him in prison, from which he was rescued by his friends. He now returned to Neuchâtel, and died there Sept. 13, 1565. See Kirchhofer, *Life of Farel* (in German, 2 vols., Zurich, 1831–33; in English, London, 1837); Blackburn, *Farel and the Story of the Swiss Reformation* (Philadelphia, 1865).

Revised by C. K. Adams.

Farewell, Cape: See Cape Farewell.

Fargo: city and railway center; capital of Cass co., N. Dak. (for location of county, see map of North Dakota, ref. 3–G); situated on the Gt. Northern, Ch., M. and St. P., and Northern Pacific railways, and on the west bank of the Red River of the North; at the head of navigation, opposite Moorehead, Minn. It has a Young Men's Christian Association building, two high schools, a Roman Catholic academy, a Congregational college, a U. S. land-office, the Holly system of water-works, sewers, gas, and electric lights, and a telephone system. It is one of the most important markets for wheat and farm machinery in the Northwest. The city suffered severely from fire June 7, 1893; the loss was estimated at $3,000,000. Pop. (1880) 2,693; (1890) 5,664; (1900) 9,589.

Editor of "Argus."

Farias, Valentin Gomez: See Gomez Farias.

Faria y Sousa, fāā-ree'āā-ee-sō'zāā, Manuel, de: historian and poet; b. at Pombeiro or Souto, Portugal, Mar. 18, 1590; studied at Braga; entered the service of the Bishop of Oporto; was envoy to Rome 1630–34; and spent the rest of his life in Madrid, where he died June 3, 1649. His historical works are his *Epitome de las historias portuguesas* (Madrid, 1628); his *Europa portuguesa* (3 vols.), *Asia portuguesa* (3 vols.), and *Africa portuguesa*, published at Lisbon, 1678–80, and containing valuable information in regard to the political and intellectual history of Portugal; and his commentary on the life and works of Camoens (4 vols., Madrid, 1639), a work which can lay no claim to trustworthiness. He is also the author of a number of moral dialogues, characterized, as are indeed all his works, by a very pedantic and tedious display of learning. These dialogues were published at Madrid in 1624, under the title *Noches claras, Primera parte.* As a poet he was a pupil of Gongora's *estilo culto*, and his four volumes of poems (published in Madrid, 1644–46) have little literary merit.

H. R. Lang.

Faribault, făr-i-bō': city and railway center; capital of Rice co., Minn. (for location of county, see map of Minnesota, ref. 10–F); situated at the confluence of Straight and Cannon rivers; 53 miles S. of St. Paul. It has State schools for the deaf, for the blind, and for the imbecile; Seabury Divinity College, Shattuck school for boys, and St. Mary's school for girls, all Protestant Episcopal; Bethlehem academy for girls (Catholic); public library and reading-rooms, 2 parks, 4 flouring-mills, a woolen-mill, 2 furniture-factories, rattan-works, a manufactory of windmills, 2 carriage-factories, water-works, gas-works, and electric lights. Pop. (1880) 5,415; (1890) 6,520; (1900) 7,868.

The so-called "Faribault plan" of public education, adopted here in 1891 but abandoned in 1893, caused considerable controversy among Roman Catholic writers. It was a compromise between the common-school system of the U. S. and the parochial system of the Roman Catholic Church, and involved the surrender of the parochial school property to the city board of education, the expense of conducting the schools to be borne by the city, the employment by the board of sisters of the Church as teachers, subject to the usual examinations, and the exclusion of religious teaching and emblems; although religious instruction was to be permissible after school hours if any wished it. EDITOR OF "REPUBLICAN."

Fari'na [Lat., flour > Fr. *farine*]: a powdered preparation of cereal grains, pulse (peas, beans, etc.), or in a still wider sense it includes the starchy preparations prepared as food from various roots and stalks, such as arrowroot, sago, tapioca. From the fact that such substances abound in starch, starchy food is often called farinaceous.

The pollen of flowers, after it has been gathered by bees, is also called farina. This is made into bee-bread, to serve as food for the larvæ, and probably enters into the paste which covers the larva-cells of honeycomb.

Farinelli, fă̄ā-rē̆e-nel'li, CARLO: Italian soprano singer (proper name CARLO BROSCHI); b. at Naples, Jan. 24, 1705; studied under Porpora; performed with applause in London 1734–35; and in 1737 went to Madrid to sing to and soothe King Philip V., and, succeeding, became his favorite, as also the favorite of Ferdinand VI., Philip's successor. He spent the last years of his life in great splendor. but lonesome and melancholy. D. at Bologna, July 15, 1782. He was a eunuch, and not only the best singer of the eighteenth century but a complete marvel with respect to voice, and possessed of fine musical education. He displayed brilliant talents for court-intrigue at Madrid, but possessed many amiable and even generous traits.

Farini, fă̄ā-ree'nē̆e, CARLO LUIGI: Italian statesman, historian, and orator; b. at Russi, in the Roman States, Oct. 22, 1812; studied medicine and wrote medical treatises. Proscribed for political offenses in 1843, he returned after the amnesty proclaimed by Pope Pius IX. in 1846, and was chosen a member of Parliament for Faenza; then exiled again 1848–49, but was Minister of the Interior in Piedmont in 1850. He took part in negotiations with Napoleon III., and was named dictator of Modena 1859. In 1860 he was commissioner extraordinary to the court of Naples. In the last cabinet of Cavour he was Minister of Commerce, and was president of the cabinet Dec., 1862, holding the position until Mar. 24, 1863, when he retired on account of ill-health. D. Aug. 1, 1866. *Storia della Stato Romano dall' anno 1815 al anno 1850* (1850), of which the first part was translated into English by Mr. Gladstone; *Letters to Mr. Gladstone* (1856); and *Letters to Lord John Russell* (1859), are among his works. His remains were originally buried at Turin, but were in 1878 removed to his native town, and monuments have been erected to his memory there and at Ravenna.

Farjeon, BENJAMIN LEOPOLD: English novelist; b. in 1833. He spent some years in Australia and New Zealand, engaged in journalism. Among his numerous novels, which deal mainly with low life and have been compared to Dickens's, are *Grif* (1870); *London's Heart* (1873); *Bread and Cheese and Kisses* (1874): *Toilers of Babylon* (1888); *The Betrayal of John Fordham* (1897), and *Pride of Race* (1900). H. A. B.

Farlow, WILLIAM GILSON, M. D.: botanist; b. Dec. 17, 1844, in Boston, Mass.; graduated at Harvard, A. B. 1866, M. D. 1870; appointed assistant Professor of Botany at Harvard University 1874–79, and in 1879 Professor of Cryptogamic Botany. He is a member of the National Academy of Sciences, the American Academy, and several European societies. His principal work has been upon the lower plants, and his publications upon this subject have given him the position of leading American cryptogamic botanist. His principal publications are *Marine Algæ of New England*; *The Black Knot*; *The Gymnosporangia of the United States*; *Enumeration of the Peronosporeæ of the United States*; *Host Index of Fungi*, etc.

Farmer, HUGH: English Dissenting clergyman of great learning and ability; b. on the Isle Gate farm, near Shrewsbury, Jan. 20, 1714; studied under Dr. Doddridge at Northampton, and from about 1737 was pastor of a congregation at Walthamstow, London, where he died Feb. 5, 1787. Published *Inquiry into the Nature and Origin of our Lord's Temptation in the Wilderness* (London, 1761; 5th ed. 1822), designed to show that the temptation was not objective and real; *A Dissertation on the Miracles* (1771; 3d ed. 1810); *Essay on the Demoniacs of the New Testament* (1775; 3d ed., really the 4th ed., 1818)—famous books in their days, real contributions to the growth of thought, their interest now mainly historical; *Prevalence of the Worship of Human Spirits in Ancient Heathen Nations* (1783).

Farmer, RICHARD: Shakspearean scholar; b. at Leicester, England, in 1735. He was educated in the free grammar school of his native town and at Emmanuel College, Cambridge; became a classical tutor in the latter institution in 1760, and a master in 1775, and was appointed librarian at the university in 1778. He held various benefices at Lichfield, Canterbury, and St. Paul's, but he twice declined the offer of a bishopric, unwilling to give up the free-and-easy life he was used to. The only monument of his learning and industry he has left is his *Essay on the Learning of Shakspeare*, published in 1766, and afterward often reprinted. D. at Cambridge, Sept. 8, 1797. See John Nichols, *Literary Anecdotes*.

Farmer City: city and railway junction; De Witt co., Ill. (for location of county, see map of Illinois, ref. 6–E); on the Peoria Division of the Cl., Cin., Ch., and St. L. Railway, and on the Springfield Division of the Illinois Central; 25 miles S. E. of Bloomington. It has churches of four denominations and an excellent high school, and is a trading-center of a rich agricultural district, especially known for its fine and fast horses. Pop. (1880) 1,289; (1890) 1,367; (1900) 1,664. PUBLISHERS OF "JOURNAL."

Farmers' Alliance, or **National Farmers' Alliance and Industrial Union**: a political organization of the U. S., the outcome of a movement which led, shortly after the civil war, to the formation of the Patrons of Husbandry, more commonly known as the Grange. The object of this organization was the mutual protection of farmers against the encroachments of capital. The first Alliance proper was formed in Texas to oppose the wholesale purchase of public lands by private individuals. The Alliance remained a Southern organization for about ten years. The Farmers' Union of Louisiana united with it in 1887 under the name of Farmers' Alliance and Co-operative Union of America. The order quickly established branches in Missouri, Kentucky, Tennessee, North and South Carolina, Georgia, Alabama, Florida, and Mississippi. The Agricultural Wheel, a similar society, located in the States of Arkansas, Missouri, Kentucky, and Tennessee, was later in the same year amalgamated with the Alliance in a new organization which took the name of Farmers' and Laborers' Union of America. The same spirit which led to this movement in the South had been embodied in Illinois in the National Farmers' Alliance which was started in 1877 and quickly spread to Wisconsin, Minnesota, Iowa, Missouri, Kansas, and Dakota. A minor organization, the Farmers' Mutual Benefit Association, started in 1887 in the southern part of Illinois. In 1889 these different bodies were all practically united into a union for political purposes at a meeting held in St. Louis. The object of the organization was to procure legislation in the interests of farmers and laborers, and the present name, that of Farmers' Alliance and Industrial Union, was then taken. The professed reason for the formation of an Alliance party in politics was that the already existing parties totally failed to undertake the adjustment of the problems covered by the Alliance demands. The Alliance entered the political field in Kansas at once, and it is here that the organization has achieved its greatest victories. At the meeting held in Topeka in June, 1890, which was attended also by the Knights of Labor, the new People's Party was formed, though it was left to the individual member's choice in the case of both organizations whether he should co-operate in the political movements or not. At this convention a platform was adopted and a State ticket nominated. The election resulted in the triumph of the new party, which elected an attorney-general, 5 out of 7 Congressmen, 93 out of 125 members of the State House of Representatives, and one U. S. Senator. On May 19, 1891, delegates from the Farmers' Alliance, Knights of Labor, and several other similar organizations met in a national union conference in Cincinnati, adopted a platform, and formed a new national political party called the People's Party of the United States of America. The organizations represented did not, however, heartily indorse the new party. In Nov., 1891, delegates from the Farmers' Alliance, Farmers' Mutual Benefit Association, and People's Party met in Indianapolis, and an earnest effort was made to bring about an amalgamation of the three organizations, but opposition to this purpose was developed, and action toward that end was postponed to the meeting of the National Industrial Conference at St. Louis, Feb. 22, 1892. The Farmers' Alliance was represented in this conference by 246 delegates out of a total of 656, and it was decided at this meeting to appoint a committee to act with the People's Party national committee on the nomination of a national ticket, and to hold a national convention for that purpose. A platform was also adopted. For the political aspects and principles of the organization, see PEOPLE'S PARTY. C. H. THURBER.

Farmers' Clubs: associations of agriculturists, generally those of some one community or neighborhood, who meet at stated times for the discussion of questions affecting the interests of agriculture, and more especially for considering the methods of practical farming—the relative values and uses of different fertilizers, the adaptation of special crops to particular soils, the choice of breeds of live-stock and of varieties of cultivated plants, and the like. Solon Robinson and Horace Greeley were among the early and influential advocates of farmers' clubs. They were associated with the Farmers' Club of the American Institute in New York, the discussions of which were for many years printed weekly in the *New York Tribune*, and widely read. Some farmers' clubs have libraries and invested funds, and sustain regular courses of lectures in the winter season, and in general ladies are admitted. The constitution and by-laws are, or should be, simple in plan, and the meetings are social rather than formal. In many places, besides the regular discussion, there is the reading of one or more original papers, usually agricultural, and music adds variety to the exercises. To some extent the old farmers' clubs have been converted into or replaced by the granges of the Patrons of Husbandry and the farmers' institutes. See GRANGE and FARMERS' INSTITUTES.

Farmers-general: an association of persons in France, under the old monarchy, to whom the privilege of levying certain taxes, as imposts on salt or tobacco, or town-dues in particular districts, was farmed or let out for a given sum paid down. This system of raising the public revenue was employed by the Roman state. (See PUBLICANS.) It was introduced into France in the thirteenth century, when Philip the Fair gave to Lombard Jews and brokers the privilege of collecting the *gabelle*, or tax on salt, to provide means for carrying on war against the English. It continued to be employed under various modifications down to 1789. In 1720 the farmers of the taxes formed a regular association, called the *ferme générale*, with exclusive management of the *gabelle*, the tax on tobacco, the *octrois* of Paris, and other excise duties. These men accumulated enormous wealth, and by bribing ministers of state, courtiers, and functionaries of all classes had influence enough to keep up the ruinous system. Turgot and Necker, in the reign of Louis XVI., attempted to change the arrangement, but the nobility, clinging to their privilege of exemption from taxation, effectually resisted their efforts. By the revolutionary constitution of 1791 the system was swept away, and many of the farmers-general were afterward executed. Revised by A. T. HADLEY.

Farmers' Institutes: the series of meetings held in many of the U. S. under the auspices, directly or indirectly, of the Government of the particular State, usually during the winter, in which the various agricultural operations and the various matters pertaining to the farmer's life are discussed. The central organization usually is vested in some State agricultural society or the agricultural college, and itinerant lecturers are sent to the various meetings to co-operate with the local speakers. Each meeting lasts from one to four days, during which time all the leading agricultural problems of local interest are touched upon. About thirty States appropriate funds, either directly or through the official State agricultural organization, for the maintenance of institutes. The amounts vary considerably, being led by New York with $15,000 per annum and Wisconsin with $12,000. About $100,000 are now spent annually in the U. S. and Canada for this purpose. The State institutes are stimulating the organization of many local and county institutes and farmers' clubs, so that the institute movement, considered as a whole, reaches nearly every farming community, at least in the North.

Although the institute movement has acquired the greater part of its momentum since 1880, it really originated about the middle of the nineteenth century. The proceedings of the New York State Agricultural Society for 1842–43 record what is perhaps the first real concerted effort to establish itinerant agricultural lectures and instruction. A similar movement was made by the Massachusetts State Board of Agriculture in 1859. In 1861 the State Board of Agriculture of Michigan, which controls the State Agricultural College, was authorized to "institute winter courses of lectures for others than students of the institution, under necessary rules and regulations." This appears to be the first attempt to connect a farmers' lecture-course with an educational institution. Ten years elapsed, however, before such lecture-courses were actually provided. For a fuller history and statement of funds expended, see Bailey, *Annals of Horticulture for 1891*. L. H. BAILEY.

Farming: See AGRICULTURE.

Farmington: town; Hartford co., Conn. (for location of county, see map of Connecticut, ref. 9–G); on Farmington river and on the Northampton Division of the N. Y., N. H. and H. Railroad; 31 miles N. of New Haven. It has an excellent school for girls, established in 1844, a savings-bank, and important manufactures. The town was settled in 1640. Pop. of township (1880) 3,017; (1890) 3,179; (1900) 3,331.

Farmington: town; Van Buren co., Ia. (for location, see map of Iowa, ref. 7–J); on the Des Moines river, and on the Ch., B. and K. C., and the Ch., R. I. and Pac. railways; 30 miles N. W. of Keokuk. It has a woolen-factory, a grist-mill, manufactures of cigars, brooms, and trusses, a wagon and carriage factory, electric lights, and water-works. Pop. (1880) 781; (1890) 1,002; (1900) 1,332.
EDITOR OF "HERALD."

Farmington: village; capital of Franklin co., Me. (for location of county, see map of Maine, ref. 7–B); on the Maine Central Railroad; 80 miles N. E. of Portland. It has a State normal school, a family school for boys, an excellent high school, and graded public schools, numerous machine-shops, saw and grist mills, manufactories of novelties in wood, spool-factory, several corn-canning factories, an electric-light plant, etc. Its schools make it one of the best educational centers in the State. Principal business, mercantile, farming, and dairying. Pop. of township (1880) 3,353; (1890) 3,207; (1900) 3,288; of village (1890) 1,243; (1900) 1,251.
EDITOR OF "CHRONICLE."

Farmington: city; capital of St. François co., Mo. (for location of county, see map of Missouri, ref. 5–J); $2\frac{1}{2}$ miles from the St. L. and Iron Mountain Railroad; on the turnpike leading from Iron Mountain to Ste. Genevieve; 87 miles S. of St. Louis. It has the Elmwood Female Seminary (Presbyterian), Carleton College, Baptist College, and a very large public school. In the vicinity are many important lead-mines, also Iron Mountain. Pop. (1880) 608; (1890) 1,394; (1900) 1,778. EDITOR OF "TIMES."

Farmington: town (incorporated in 1798); Strafford co., N. H. (for location of county, see map of New Hampshire, ref. 8–G); on a branch of the Boston and Maine Railroad, 28 miles W. N. W. of Dover and 86 miles N. of Boston, Mass.; 10 miles S. E. of Alton Bay. It has three churches, a high school, and manufactures of boots, shoes, and lumber. Pop. of township (1880) 3,044; (1890) 3,064; (1900) 2,265.

Farm Laws: See the Appendix.

Farmville: town; capital of Prince Edward co., Va. (for location of county, see map of Virginia, ref. 7–G); on railway and on the Appomattox river; 70 miles S. W. of Richmond, and 7 miles N. of Hampden-Sidney College and the Union Theological Seminary. It has a State school for women, and several large tobacco-factories and warehouses. Principal business, tobacco-trade. Pop. (1880) 2,058; (1890) 2,404; (1900) 2,471.

Farnaby, or **Farnabie**, THOMAS: grammarian and teacher; b. in London, 1575. He was educated at Oxford; became a Roman Catholic, and went to Spain, where he entered a Jesuit college. He soon left it, and after some experience in the army finally settled at Martock, in Somersetshire, where he opened a school, This undertaking proved so successful that after the lapse of a few years he was able to remove the institution to London, where his success was still greater. His school contained more than 300 pupils, most of whom were sons of noblemen, boarding in his house, and more churchmen and statesmen issued from it than from any other in the kingdom. He finally removed the institution to his estate, Oxford, in Sussex. He published annotated editions of a great number of ancient authors and a *Systema Grammaticum* (London, 1641). D. at Oxford in 1647.

Farnam, HENRY WALCOTT: Professor of Political Economy; b. at New Haven, Conn., Nov. 6, 1853; educated at Yale (A. B. 1874 and M. A. 1875); studied three years in

Germany, taking degree at Strassburg 1878; University Professor of Political Economy at Yale 1880; Professor of Political Economy Sheffield Scientific School 1881; editor of *Yale Review* 1892; author of *Die Innere Französische Gewerbepolitik von Colbert bis Turgot* (Leipzig, 1878), etc.
C. H. THURBER.

Farne, or **Fern, Islands**: a group of seventeen islets and rocks, some of which are visible only at low tide; situated 2 to 5 miles off the east coast of England, opposite Bamborough, Northumberland. On two of the islands lighthouses have been built, as navigation is extremely dangerous in these waters. On another of the isles is a tower raised in honor of St. Cuthbert, who lived there during the last two years of his life. Latitude of Farne lights, 55° 37′ N., lon. 1° 39′ E.

Farnese, faar′nēez (Ital. pron. fa͡ar-nā′sā): the name of a noble Italian family, many of whose members have played conspicuous *rôles* in the history of Europe. For the greater part the family owed its prominent position and immense wealth to the circumstance that one of its members, Alexander Farnese, became pope (Paul III., 1534–49) and in the most shameless manner misused the influence and revenue of his position for the advancement of his family. He made his son Pierluigi (1493–1547) Duke of Parma and Piacenza, and he provided in an equally lavish manner for his four grandsons, two of whom, Alexander and Ranuccio, were made cardinals when they were fourteen years of age, while a third, Ottavio Farnese (1520–86), was married in his twelfth year to Margaret of Austria, better known under the name of Margaret of Parma, a natural daughter of Charles V., and succeeded his father as Duke of Parma; and the fourth, Orazio, was made Duke of Castro and married to Diana, a natural daughter of Henry II. of France.

The most celebrated member of the family was ALEXANDER FARNESE (1546–92), Prince of Parma and governor of the Low Countries. He was a son of Ottavio Farnese and Margaret of Parma, was educated at Alcala and Madrid, fought with great distinction in the battles of Lepanto and Gembloux, and succeeded his uncle, Don Juan of Austria, as governor of the Low Countries. He was one of the greatest generals of his age. The conquest of Antwerp, the raising of the siege of Paris, etc., were brilliant feats of courage and skill, and the failure of the invasion of England was due to no fault of his. But he was also one of the greatest diplomatists of the age; he conquered as many cities by his tongue as by his sword. He created a party in the Low Countries in favor of the union with Spain; and when the Armada was about to sail, neither Elizabeth nor Raleigh had the least suspicion of what the movement really meant. But he was ill rewarded by Philip II., who recalled him in the midst of his career. He was on the way to Spain when he died.

In 1731 the male line of the house became extinct by the death of Antonio Farnese. But Antonio's daughter, Elizabeth Farnese, married to Philip V. of Spain, succeeded in securing all the Farnese fiefs for her sons, Philip, Duke of Castro, and Charles, King of Naples, and afterward King of Spain.

Farnese Bull: a marble group formerly in the Farnese palace at Rome, but removed with other art treasures in 1786 to the National Museum at Naples. It represents the punishment of Dirce, whom Amphion and Zethus are tying to the horns of a bull. Apollonius and Tauriscus are said by Pliny to be the joint authors of the work, which was discovered in the baths of Caracalla in 1546 and was restored by Bianchi under the guidance of Michelangelo. See APOLLONIUS OF TRALLES.

Farn′ham: a town of England; in the W. of Surrey; on the left bank of the Wey; 40 miles from London (see map of England, ref. 13–I). It contains the fine old castle of the bishops of Winchester, first built by Bishop de Blois, brother of King Stephen, but razed by Henry III., then rebuilt by Charles I., and, having been dismantled, restored to its present state in 1684. Farnham is principally noted for the superior hops which are cultivated in the surrounding country; it is abundantly supplied with water from neighboring springs. The parish church is spacious and of the later Gothic style. It was once a chapel of ease to Waverley Abbey, now in ruins, which was founded in 1128. Aldershot Camp is situated 3 miles N. E. of Farnham. Pop. 5,000.

Farnham, Quebec, Canada: See WEST FARNHAM.

Farnham, ROSWELL: lawyer and soldier; b. in Boston, Mass., July 23, 1827; removed in 1840 to Bradford, Vt.; graduated with honors at the University of Vermont in 1849; taught school for several years; admitted to Orange County bar in 1857; State attorney 1859–61; lieutenant of First Vermont Regiment 1861; provost-marshal of Newport News, Va., 1861; captain of Bradford Guards 1862; lieutenant-colonel Twelfth Vermont Regiment during its service in the field; member of Vermont Senate from Orange County 1868–69; delegate to Republican national convention at Cincinnati in 1876, and also one of the presidential electors the same year; trustee of the University of Vermont; Governor of Vermont 1880–82.

Farn′worth: township of Lancashire, England; 12 miles E. S. E. of Liverpool (see map of England, ref. 7–F); manufactures sail-cloth, watches, files, and all kinds of iron tools. Pop. (1891) 23,758.

Faro [deriv. of *Pharaoh*, because of a conventional representation of the Egyptian Pharaoh formerly contained on one of the cards. Cf. Fr. *pharaon*]: a game at cards, used only in playing for money. It is played in different ways in different countries, but in all the player contends against a bank, represented by a professional faro-banker; and the chances, though apparently only slightly in favor of the bank, are in reality quite strongly so. In the U. S. the game is illegal in many cities and in some of the States.

Faro, faa′rō: the capital of the province of Algarve, Portugal; situated at the mouth of the Fermosa, where three small islands form a somewhat confined but otherwise convenient and safe harbor (see map of Spain, ref. 19–B). Faro exports considerable quantities of oranges, figs, anchovies, and cork, and is a bishop's see. Pop. 8,100.

Faro: a province of Portugal. See ALGARVE.

Faröe Islands: same as FAEROE ISLANDS (*q. v.*).

Farquhar, faar′*k*har, GEORGE: dramatist; b. at Londonderry, Ireland, 1678; educated at the University of Dublin; acted for a short time at a theater in Dublin, then retired from the stage and settled in London. *Love and a Bottle* (1698); *Twin Rivals* (1703); and *The Beau's Stratagem* (1707), comedies, were among his productions. D. in London in 1707.

Farr, WILLIAM, M. D., F. R. S., D. C. L.: statistician; b. at Kenley, Shropshire, Nov. 30, 1807; educated at Dorington and Shrewsbury and at the Universities of Paris and London. Practicing medicine in London, he edited the *Medical Annual* and the *British Annals of Medicine.* In 1839 he became connected with the registrar-general's office in London, and subsequently became superintendent of the statistical department, retiring in 1880. He wrote much for medical journals, the Vital Statistics in *McCulloch's Statistics of the British Empire*, official reports on the public health, and on the *Causes of Death in England* (1837–70), reported in detail the cholera epidemic of 1849, framed a new *Statistical Nosology*, etc. D. in London, Apr. 14, 1883.

Farragut, DAVID GLASGOW: the most distinguished admiral of the United States of America; b. at Campbell's Station, near Knoxville, Tenn., July 5, 1801; son of George Farragut, a native of Minorca, who emigrated to North America in 1776, and was a soldier in the Revolutionary war, and subsequently muster-master of the militia of East Tennessee; also magistrate of Pascagoula, Miss. He died in New Orleans in 1808, and Commodore David Porter, of the U. S. navy, who had formed a friendship with the family, adopted David Farragut, and procured him an appointment in the navy, which he entered as a midshipman Dec. 17, 1810. He served under Commodore Porter on board the Essex, and at the age of twelve was made prize-master of a captured vessel. In 1815–17 he served on the Independence and the Macedonian in the Mediterranean; spent nearly a year, 1817–18, in study at Tunis under the U. S. consul, Charles Folsom; in 1819 became acting lieutenant on board the Shark; in 1820 returned to the U. S., and in 1822–23 took part in several conflicts between the U. S. naval forces under Commodore Porter and the pirates of the West Indies. In 1825 he was commissioned lieutenant and ordered to the frigate Brandywine; and after serving in various vessels reached the rank of commander in 1841. During the Mexican war he blockaded the harbor of Tuxpan with the sloop of war Saratoga. From 1848 to 1850 he was on duty at the Norfolk navy-yard; in 1850 was ordered to Washington to aid in compiling a book of ordnance regulations for the navy. From 1854 till

1858 he was engaged in establishing the navy-yard at Mare Island, in San Francisco Bay. In 1858 he was given command of the sloop of war Brooklyn. He passed the winter of 1860–61 at Norfolk, Va. In Dec., 1861, he was placed in command of the steam sloop of war Hartford in an expedition commanded by David H. Porter, sent to capture New Orleans. The force included the West Gulf blockading squadron and Porter's mortar flotilla, and was the largest expedition that ever sailed under the U. S. flag. The fleet sailed from Hampton Roads, Feb. 2, 1862; on Apr. 24, under Farragut's directions, it passed Forts Jackson and St. Philip at the mouth of the Mississippi, destroyed a Confederate fleet of fifteen vessels, the loss on the Union side being thirty-seven men and the gunboat Varuna, which was sunk, silenced the Chalmette batteries 3 miles below New Orleans, and on the 25th accomplished the surrender of the city. On June 28 Farragut's fleet, after an engagement of about two hours, passed the batteries at Vicksburg, and again passed the batteries on his return on July 15. The following day he was commissioned rear-admiral. In Mar., 1863, he ran the fire of the forts at Port Hudson and opened communication with Flag-Officer Porter, who commanded the upper Mississippi. On May 24, in conjunction with the army, he commenced active operations against Port Hudson, and when it fell, on July 9, he turned over to Admiral Porter the entire control of the Western waters above New Orleans. After a short respite from his labors, he, in Jan., 1864, made a reconnoissance of Forts Morgan and Gaines, the defenses of Mobile, and expressed the opinion that with a single ironclad and 5,000 men he could take that city.

On Aug. 5, 1864, with four ironclads and fourteen wooden vessels, Farragut passed the forts at the entrance of Mobile Bay, after a desperate engagement, in which the Tecumseh, one of the vessels of his fleet, was sunk by striking a torpedo, and 335 men in all were lost. During the fight Farragut gave his directions from a place high up in the main rigging of the Hartford. In a few days the forts surrendered, and the passage of blockade-runners was stopped, although the city itself was not taken, because of shoal water and obstructions in the channel. In November Farragut returned to the North, and in New York was presented with a purse of $50,000 for the purchase of a home in that city. On Dec. 22 a bill creating the grade of vice-admiral was created, and on Dec. 23 Farragut was nominated for the office by President Lincoln. On July 25, 1866, Congress created the grade of admiral and the rank was given to Farragut. In 1867, in the flagship Franklin, he commanded the European squadron, and was received with highest honors in the cities he visited. In 1870 he passed the summer at Portsmouth, N. H., and died there on Aug. 14. He was buried in Woodlawn Cemetery, New York. Among the memorials erected in his honor are statues in Madison Square Park, New York, and in Marine Park, South Boston, Mass. See Com. Foxhall Parker, *The Battle of Mobile Bay* (Boston, 1878); the *Life* by Loyall Farragut (New York, 1879); Capt. A. T. Mahan, *Admiral Farragut* (New York, 1892).

Farrakhabad′: city of the Agra division, Northwestern Provinces, British India; the capital of the district of the same name; on the Ganges, on the road between Calcutta and Delhi; 3 miles W. of the military station of Fathigarh, with which it is sometimes confounded on maps (see map of N. India, ref. 6–F). It is one of the commercial centers of Upper Hindustan. Lord Lake defeated the troops of Holkar here in 1805. Pop. 65,000.

Farrar, Frederic William, D. D., F. R. S.: English divine and author; son of a clergyman; b. in the Fort, Bombay, India, Aug. 7, 1831; graduated at Cambridge in 1854; became assistant master at Harrow in 1855, and master of Marlborough College in 1871; rector of St. Margaret's, London, and canon of Westminster 1876; archdeacon 1883; chaplain of the House of Commons 1890, and dean of Canterbury 1895. He is also chaplain in ordinary to the Queen. He has published the following works of fiction: *Eric* (10th ed. 1858); *Julian Home* (4th ed. 1859); *St. Winifred's* (4th ed. 1863): *Darkness and Dawn* (1891; 3d ed. 1892). His philological works are *The Origin of Language* (1860); *Chapters on Language* (1865); *Greek Grammar Rules* (6th ed. 1865); *Greek Syntax* (3d ed. 1867); and *Families of Speech* (1870). His more important theological works are *Seekers after God* (1869); *The Witness of History to Christ* (1871); *The Silence and Voices of God* (1873); *The Life of Christ* (in 2 vols., 1874); *The Life and Works of St. Paul* (2 vols., 1879); *The Early Days of Christianity* (2 vols., 1882); *The Messages of the Books: Discourses and Notes on the New Testament* (1884); *The History of Interpretation* (Bampton Lectures, 1886); *Lives of the Fathers* (2 vols., 1889). He also contributed to Smith's *Dictionary of the Bible*, and is master of a singularly fresh and brilliant style. He delivered a eulogy on Gen. Grant in Westminster Abbey, Aug. 4, 1885, and in the same year lectured in the U. S.

Revised by S. M. Jackson.

Farrar, John: b. at Alnwick, Northumberland, July 29, 1802; educated near Leeds; became a Wesleyan minister in Aug., 1822; was governor of Abney House Wesleyan Theological Institution, Stoke Newington, London, in 1839; and subsequently of Headingley College, Leeds (1868); was secretary and president of the Wesleyan Conference, the latter in 1854 and in 1870. D. at Headingley, Leeds, Nov. 19, 1884. Wrote *Proper Names of the Bible* (1839); *A Biblical and Theological Dictionary* (London, 1851); *Ecclesiastical Dictionary* (1853).

Farren, William: actor; b. in London, England, in 1825. His father was a well-known comedian of the London stage, contemporary with Macready, and was descended from a family of actors. Previous to entering the dramatic profession he appeared in London with some success as a singer at concerts. At the outset of his stage career he performed at the Strand and Olympic theaters under the name of Forrester and as William Farren, Jr. In Jan., 1851, he became a member of the company of the Olympic theater, and on Jan. 13 he played the part of Frederick Plum in the first performance of Morton's comedy *All that Glitters is Not Gold*. In 1853 he joined Buckstone's company at the Haymarket theater, where he appeared as Captain Absolute, Mar. 28, in *The Rivals*. At the Vaudeville theater, in July, 1872, he played Sir Peter Teazle in a revival of *The School for Scandal*. In 1875, at the same house, he was the Sir Geoffrey Champneys in the comedy of *Our Boys*, which character he continued to play without intermission until July, 1878. At the Shaftesbury theater in 1888 he appeared as Adam in *As You Like It*. In 1890 he played in *David Garrick*, and took the part of Sir Peter Teazle in a revival of *The School for Scandal* in 1891. B. B. Vallentine.

Farrer, Henry: landscape-painter; b. in London, Mar. 23, 1843; "self-taught"; removed to the U. S. in 1861; member American Water-color Society. He exhibits chiefly paintings in water-color. His work is carefully wrought out, but is somewhat dry in general aspect. Studio in New York. W. A. C.

Farriery [deriv. of *farrier*, horseshoer < M. Eng. *ferrour*, *ferrer*, from O. Fr. *ferreor*, *ferrier* < Low Lat. *ferra′tor*, *ferra′rius*, shoer, derivs. of *ferra′re*, to shoe, deriv. of *fer′rum*, iron, horseshoe]: originally the trade of applying iron to the horse's foot. However, as all horse-surgery was of the coarsest and often of the most brutal kind, performed by the common smith with the tools and implements at hand, it is natural that veterinary surgery as it grew into a profession should have been called *farriery*. Now, however, the treatment of the diseases of domestic animals is no longer of necessity left to the guesswork of the blacksmith, nor surgical operations to the tongs and searing-iron.

The foot of the horse is wonderfully guarded against injury from without, and equally protected against painful jars and disease which one might suppose would arise from the tremendous blows which the feet sustain when traveling upon hard roads. The hoof is a tough, elastic, hornlike substance, completely boxing in the delicate tissues, cushions, and bones of the foot. In the living animal and in its first state it is in one piece, but after maceration it may be separated into the crust or wall, the sole, and the frog. The front part of the crust of each hoof is called the toe, the hindmost parts the heels, and the intermediate parts the quarters. The corresponding parts of the shoe have the same names. The *crust* grows from the coronet, at the top of the hoof next the hair, and from the sensitive laminæ which surround the pedal or coffin bone upon its upper sides. It is about half an inch in thickness at the edge, and in many horses so hard and tough that they hardly need shoeing at all except in icy weather or when used upon paved roads. The *sole* is a slightly arched dome with a large segment removed, in the place of which the frog is found. The horn of the sole differs essentially from that of either the crust or the frog, it being more granular and shelly, wearing off naturally with comparatively little abrasion. At the rearward portions of the sole, divided as they are by the frog, two elevated ridges, of a character of horn more resembling the crust, occur. These are called the *bars*, and are really the ends of the crust reflected inward at the heels. The *frog* is a wedge-shaped body in form like a sharp-pointed V, the point being turned forward. It is of an exceedingly spongy and elastic kind of horn, and is placed as a cushion between the navicular bone and joint and the ground, to relieve concussion and to distribute jars so as to break their force. With every step of the natural foot, unshod as well as when at rest, the frog communicates a pressure directly upon the navicular joint and the tendons which underlie it. In ordinary shoeing the frog never touches the ground, being cut away and left reduced in size, while at the same time the foot is lifted up from the earth by thick-heeled or calked shoes. That a foot so treated becomes diseased is not to be wondered at. The wonder is that acute diseases of the foot are not much more prevalent. The flexibility and elasticity of the hoof, concerning which so much is written, rests chiefly, indeed almost altogether, in the frog, slightly in the sole, and practically very little or not at all in the crust or walls of the foot. Much has been written about the expansion and elasticity of the quarters and heels. It may be disregarded. There is indeed elasticity in the crust, but it is only brought into play perceptibly under extraordinary circumstances.

When an unshod natural hoof is placed upon hard ground, the parts which bear upon it are the edge of the crust all around and the frog. Upon uneven ground the sole is frequently called upon to sustain its share of the weight, and when the horse steps upon frozen clods or stones the sole often bears the whole. In traveling upon ordinary country roads the hoof wears very evenly; upon gravelly roads the toe usually wears fastest, and will first become tender. If the toe and quarters be protected from wear by a narrow shoe, for ordinary service no other shoeing will be necessary. If such a shoe, which is the "half-moon shoe" of Coleman, drawn out thin at the quarters, be seated nearly level with the sole by cutting out the crust of the hoof upon the toe and quarters, it is evident that the horse will have his natural foot, with simply an iron front edge to take the wear. This is the lightest and best shoe a horse can wear when his work is not too severe nor upon too rough ground. Were the same principle to be carried out in a shoe similarly seated (level with the sole), much wider in the web, and extended to the heels so as to protect the foot thoroughly, the foot would still have its natural bearings, and be guarded against even extraordinary wear and tear. The frog would bear upon the ground, and so would the sole, nearly as much as if the hoof were not shod.

The presence of a shoe prevents the natural wear of the hoof; hence sooner or later, according to the rapidity of growth of the horn, it must be reset and the horn pared back as nearly as possible to the condition it would have been in if it had not been shod and had worn off evenly and naturally. The earliest shoes worn by horses were probably plates of iron, having a similar shape to modern horseshoes, but covering a much larger portion of the hoof. This necessitated a paring away of both crust and sole when the shoes were reset. The sole is very easily cut by the smith, and so is the frog, while the crust is hard and tough. It is easily rasped off, however, after the sole is cut away, and the smith has plain sailing.

When a horse is brought to a common blacksmith to be shod, the "clinches" at the ends of the nails are first cut off; then the shoe is wrenched off with the tongs, a portion of the crust coming off frequently with it. This is done by an apprentice, who then proceeds to pare out the sole all around, cutting close to the frog. The cutting down of the crust is done by the smith himself, if he is a very careful man, or by an experienced journeyman, but quite as often trusted to an apprentice, who forms roughly, at his discretion, the seat for the shoe. Then the shoe is shaped, heated red hot or nearly so, and a seating burned level by the application of the hot shoe—an operation liable to do serious harm. When the shoe is formed to fit the foot it usually happens that if flat at first the heels are made nearly twice as thick as the toe, if indeed they be not turned down into calks, making the shoe at the heels half an inch to an inch or more in thickness; and thus it is applied. The result is that no part of the hoof touches the ground. The frog, upon which so much depends, is gradually reduced in size, both by the paring of the smith and (especially) by lack of use: it shrivels often to one-third its proper size. The paring out of the sole is usually accompanied by the cutting away of the bars entirely, which the smith says he does "to open the heels." The foot, thus weakened and placed in a most unnatural position, becomes the seat of disease. When the bars are cut away, or the soles pared too thin near the heels, and the frog has no bearing upon the ground, ulcers occur near the heels, which are called *corns*.

The frog should, by its constant pressure at every step, give healthy action to the navicular bone and joint; this wanting, inflammation or fever of these parts, *navicular disease*, results. To this, horses with strong, solid-looking hoofs are especially liable. Flat-footed horses are liable to another trouble from the same cause—namely, *founder*. As already said, the weight of the horse is sustained naturally upon the crust of the hoof and upon the frog. Where the frog can bear none the crust must sustain all. The crust grows in part from the sensitive laminæ enveloping the pedal-bone, and is attached to them by laminæ of horn interlocking—or, rather, interleaved—with them; and it is upon these sensitive laminæ that all the weight is thus placed. They can bear a great deal naturally, but inflammation (*laminitis*) is almost sure to come when there is a provoking cause, and the horse is foundered. *Seedy toe* is a form of laminitis, where the crust separates from the laminæ at the toe. *Pumice foot* is a name given to another form of laminitis, wherein the sole becomes convex instead of concave, and the horn is spongy within and externally brittle, the whole foot being in a highly feverish condition. *Contraction of the heel* comes from the same general cause—namely, want of frog-pressure. *Thrush* is a disease of the frog, made apparent by a very offensive discharge from the cleft, and results primarily from lack of use of the frog, and, except the frog be wounded, probably altogether from this cause. *Quittor* is an ulcer or abscess of the foot, resulting from bruise, nail-prick, thrush, or any other cause which may finally, if neglected, affect the coffin or pedal-bone. It can not be treated by the farrier, but presents a problem which only a surgeon can properly solve. Taken in time, a cure is possible. *Sand-crack*, *quarter-crack*, etc.—The fibers of the horn in the wall of the hoof run from the coronet to the ground direct. In hoofs subject to inflammation the secretion of horn is often of a weak character, and the fibers separate, forming a crack, or, in case of an injury to the coronet, a soft, spongy streak in the horn, causing lameness. The cause of the former is bad shoes and bad shoeing—of the latter, usually, "calking," the horse treading on his own coronet. The cure for both is causing healthy horn to be secreted by rest and counter-irritants, and shoeing so as to give bearing to the frog and sole. *Nail-prick* in shoeing shows itself either at once, in which case little harm usually results, or after the horse has been used a day or so, in which case suppuration may take place. The horse will tell which nail is at fault when the hoof is tapped by the hammer around the clinches. The offending nail must be taken out, the shoe being removed, the hole probed, and if any fetid odor be perceptible and the hoof be hot, the hole must be enlarged, and, in case of any discharge, cut out until blood flows, and the opening syringed out with chlorinated soda, chloride of zinc, or some other active prophylactic. The shoe may be replaced if necessary, provided the animal is not seriously lame, the nails being lightly driven. The foot must be kept cool and rest given. Nails picked up on the road will seldom enter the sole to do injury if it be not pared down, and thus softened and weakened: but they may be found between the frog and the bars, in which situation they seldom do much injury unless neglected. The wound should be cleaned out and syringed with some corrosive as above mentioned. *Overreaching* is when a horse throws his hind foot into the heels or against the sole of the fore foot as it is partially raised to take the step in trotting. It occasions bruises on the heels or in the sole near the toe. The former are treated by external applications—tincture of arnica, etc.; the latter like a prick or any bruise of the sole. A horse well shod will seldom overreach, but long hoofs or big toe-calks on the fore feet will cause the foot to be placed upon the ground an inch or two short of where it should rest, and this is sufficient cause for the trouble. *Interfering, or "cutting."*—A horse allowed to tread fairly on the ground seldom or never cuts himself if the shoe does not extend outside the crust.

In the Goodenough system the shoe is applied by cutting out a seating for it, leaving the sole and frog as much exposed as possible, and never applying the knife to either. It is light, has five calks or bearings, a lower surface, similar to the edge of the natural foot, is beveled on both surfaces, the nail-holes are countersunk, and the shoes are applied *cold*.

M. C. WELD.

Fars, or **Farsistan** [Pers.; from Arab. *Fārs*, Persia, from Pers. *Pārs* + Pers. *stan*, place]: a province of Persia; stretching along the eastern shore of the Gulf of Persia; between lat. 26° and 32° N. and lon. 50° and 58° E.; having an area of about 55,000 miles. The province is bounded by the Persian Gulf and the provinces of Khuzistan, Isfahan, Yezd, and Kerman. Along the gulf the land is low, sandy, or argillaceous, scorched by the sun—a desert; but the coast-line presents several convenient and secure harbors. Farther back it rises through broad terraces, separated from each other by high and wild mountain-ranges, into a flat, sandy table-land, where the large salt lake Bakhtegan occurs. The terraces are fertile and beautiful, well watered by the Bundemeer (Araxes), which flows into Bakhtegan, and by the Nabou and the Tab (Arosis), which fall into the Persian Gulf. They produce tobacco, wine, rice, dates, opium, linen, cotton, silk, and kermes. They are the home of the rose, from which is manufactured the celebrated perfume, attar. They have iron and lead mines and marble and alabaster quarries. The principal towns are Shiraz, Jehrum, Darab, and Bushire. In this province occur the ruins of Persepolis, Pasargadæ, and Shapur, and the celebrated sculptured rocks called by the Persians *Naksh-i-Rustam*. Pop. (estimated) 1,700,000.

Farther India, or **Chin-India**: See INDO-CHINA.

Farthing [M. Eng. *ferthing* < O. Eng. *fēorðung*, deriv. of *fēorða*, fourth]: a British coin; the fourth part of a penny. It was coined by the Saxons, and again by King John (1210), but the quarter of a penny, cut twice across, also passed for a farthing. In Edward VI.'s time the coinage of silver farthings ceased. An act 9 Henry V. mentions a *gold* farthing. Copper farthings were first struck in 1665; tin farthings appeared in 1684 and 1692; half farthings were coined in 1843 and 1852. A farthing is worth about half a cent.

Farthingale, or (obs. form) **Fardingale**: See CRINOLINE.

Fasano, fāā-saa'nō: town in Southern Italy; province of Apulia; on the road from Bari to Brindisi (see map of Italy, ref. 7–H). It is celebrated for its olive plantations, and carries on a considerable trade in produce. But in the summer the flies become such a plague as to drive away most of the inhabitants to the neighboring La Selva, on the hills. Pop. 18,500.

Fas'ces [= Lat. *fas'ces*, plur. of *fas'cis*, bundle]: a bundle of rods of birch or elm, sometimes having an ax (*securis*) tied up within it. Such fasces were borne by the lictors before the superior magistrates of ancient Rome. The ancient kings, the consuls, the prætors, the dictators, etc., had the fasces carried before them; while the quæstors had this distinction in the provinces only. Generals who had been saluted as imperatores had fasces crowned with laurel, a custom anciently observed with some of the other magistrates. The number of the fasces and lictors varied with the rank of the dignitary, and was different in different ages.

Fas'cia [from Lat. *fas'cia*, bandage; cf. FASCES]: in the anatomy of man and most of the vertebrate animals, a laminated tissue of fibrous or aponeurotic character found in nearly all parts of the body. There are two kinds, the superficial and the deep fasciæ. The superficial fascia lies under the skin, is of varying thickness, and is disposed into several layers of fibro-areolar substance, containing particles and layers of fat. Between its layers blood-vessels and nerves run. Its fat serves to keep the body warm. The deep fasciæ are composed of unyielding fibrous substance. They sheathe the several muscles and the entire limbs (aponeuroses of investment), or serve instead of bones for the insertion of certain muscles (aponeuroses of insertion).

Fascination by Serpents: a power of so charming weak animals by the eyes and movements of body that they are easily secured as prey. This is not a blind, overpowering force, but one which the doomed animal seems partly to appreciate, and yet is unwilling to resist entirely. Squirrels, mice, and the weaker birds are the animals which are most often captivated by this power. They are described as running in front of the fascinator by short vibrations of distance or passing round in a circle, gradually shortening the intervals until they are seized by the serpent. Often the animal during the process utters piercing cries, as if aware of its danger, and yet unable to resist. Sometimes a diversion of the animal's attention by a sudden noise, or the interposition of some material obstruction to the vision, breaks the charm and sets the captive free.

Unfortunately, thoroughly full and accurate accounts, by good observers, who have witnessed the fascination of a bird by a serpent from beginning to end, are practically lacking, but there would seem to be several more or less plausible explanations of the phenomenon. Many animals are extremely curious, and are attracted by any unfamiliar object or unusual sound. A familiar example of this is the manner in which wild ducks are attracted by the antics of a dog, which has been trained to gambol in front of a "blind" and thus draw ducks within gunshot. Squids are caught with bits of looking-glass, the electric light is used with great success to attract fishes, and many others bite readily at artificial baits which resemble nothing in nature. The antipathy of birds, and especially small ones, for owls is well known, and monkeys appear to have much the same feeling toward a snake, being at once terrified and attracted by the reptile. It may happen that the snake's original intention was to secure the young of the bird or mouse that ultimately becomes his prey, and that in the effort to frighten or coax the enemy away from the vicinity of the nest or burrow one of the parents becomes a victim instead. Or the birds or squirrels may at first be attracted toward the serpent by curiosity, or by the same impulse which leads birds to mob an owl, and as they flit back and forth, and circle around the snake, screaming with terror and anger, becoming more and more excited all the time, an incautious move brings one within striking distance.

There is still another possible explanation: It is well known that the common hen may be readily hypnotized, and music seems to have much the same effect on some small mammals, rendering them incapable of movement. The first approach of bird or mammal toward the snake may be caused by curiosity, but once sufficiently near, the snake may, even without himself being aware of it, exert a hypnotizing influence, and seeing his prey within reach naturally avails himself of the opportunity. F. A. LUCAS.

Fascines [Fr., from Lat. *fas'cina*, a bundle]: bundles of brushwood tied together. These are formed into mattresses for construction of levees and jetties, for breakwaters, and in marshy places for the foundation of piers of bridges.

Fâsher, El: See the Appendix.

Fashion [M. Eng. *fasoun*, *facioun*, shape, manner, from O. Fr. *faceon*, *façon*, thing made, making < Lat. *fac'tio*, *factio'nem*, a making, deriv. of *fa'cere*, make. Cf. FACTOR]: the peculiar shape, make, or style of anything. The etymology of the word points to special characteristics caused by the composition or construction of anything, and this is the original force of the term; thus *The Fashion of Furniture* was the well-chosen title of an essay on fitting and appropriate design in modern domestic interiors. Nearly akin to this is the most usual meaning, namely, the rapidly changing character of dress, or of table furniture, or of house-decoration, or of writing-paper, visiting-cards, or any appendage of easier and more elegant life. A bonnet which was *in fashion*, that is, in the accepted character or style of the day, in 1860, looked very odd in 1890: *the fashion*, then, is that special character or style to which the bonnet was made to conform. *The reign of fashion* is the arbitrary imposing of this character or style upon every woman, no matter what her complexion or stature, under penalty of seeming ridiculous; and, in like manner, its imposition upon every man, every carriage, the interior of every room of any elegance. *In fashion* or *in the fashion* means in accordance with the accepted character or style, when said of any object; or, when applied to a person it means clothed, gloved, and having jewelry, etc., in accordance with the accepted character or style of each object of apparel.

The extent to which changes of fashion are carried is very curious. Thus in jewelry, coral either is or is not a beautiful and effective material for necklaces, earrings, etc. If it is not so, why was it in use so freely before 1875? If it is so, why was it wholly neglected and despised for the fifteen years thereafter? Or if pink coral is becoming to one person and not to another, why is it worn by all when in fashion, and abandoned by all when the fashion changes? Earrings in the form of long pendants may be thought highly becoming to one woman, and large, light hoop-earrings becoming to another, and a third will do well to have no earrings at all; but fashion decides that all women shall wear pendants from 1860 to 1870, that all shall wear small knobs or buttons hugging the lobe of the ear close from

1870 to 1890, and that after 1890 no earrings at all shall be worn by any woman calling herself elegant. In 1820 women wore their gowns so close and straight that even young girls were unable to step across a moderately wide gutter in the street. In 1850 the circumference of a lady's gown, at the hem, was perhaps eight yards. In 1890 the skirt was as straight and slim in appearance as in 1820, but had nearly as much stuff in it as in 1850.

For many years before 1852 no Englishman of social position dared wear a mustache, or any part of the beard except whiskers, unless he were a cavalry officer or an artist. The following year there was a "beard movement," if we may believe *Punch*; at all events from 1853 on it has been tolerably free for Englishmen to wear more or less hair on the face. Here is an instance of freedom from the rule of fashion: any man may wear his full beard, or any part of it, or none, as his appearance or his desire to avoid trouble may bid him, but at any moment this freedom may cease to exist. The hair of men's heads has never been emancipated; for about 1852 or 1853 there was a sudden order issued to cut the hair short, and that order has remained in force ever since.

These are only illustrations of the tyranny of the rule of fashion in matters which would naturally be thought free from it. It may be harmless in these instances. It is in dress and other ornamental arts that this rule of fashion does serious harm. No great care and no sincere feeling will be put into designs which are prepared for the brief use of a season or two. If the silks of elaborate *damassé* patterns which "come into fashion" in the autumn are not only to be of wholly different patterns next year and the old ones unfit to be seen, but also to be wholly abandoned in favor of plain striped fabrics the third year, then the patterns of the costly silks will not be well drawn, not rich, not graceful. That is a well-known truth: it results from the indifference of the designer for a thing which he knows will not endure, from the careless treatment by the merchant of the one-year investment, and from the absence of any awakened respect for the decorative art involved on the part of the buyers and wearers of such fabrics. The patterns and the ornaments of two years ago, or even of one year ago, very often, are absolutely out of the market this year. The large dealers would not dream of offering them, or of keeping them for those who might ask.

It is a sort of sin against commercial laws to have any old-fashioned goods on hand. Once, when some wall-papers, the accumulation of several years of an architect's work for his clients, were sent to an emporium for sale, there was serious complaint, as of dishonesty, "that Mr. X. should offer that paper as if it were a new paper, when Mr. Y. had had it on his parlor walls for three years." Of course no fine designing in wall-papers is possible if only the year's goods are salable during the year, and each dealer hurries the old ones out of sight and out of existence to make room for the new styles. See DECORATIVE ART, and for consideration of fashions in dress see COSTUME.

RUSSELL STURGIS.

Fasho'da: a large town in the Egyptian Sudan. See the Appendix.

Fassett, CORNELIA ADÈLE: See the Appendix.

Fast: a period of voluntary abstention from food, particularly as a religious discipline. All ancient nations known to history had their fasts—the Egyptians, the Phœnicians, the Assyrians, the Indians, and after these the Greeks and Romans.

Extraordinary religious acts were preceded by fasts. The mysteries demanded this discipline, especially from those about to be admitted to them. In consequence of certain prodigies the Sibylline books directed "a fast in honor of Ceres to be instituted and to be kept every fifth year." (*Livy*, lib. 36, c. 37.) A stated fast imposed by Jupiter is spoken of by Horace (*Satires*, ii. 3). Fastings were sometimes practiced before undertaking military enterprises, or whenever there was special cause to seek the favor of the gods or to avert their anger. A notable instance is given in the book of Jonah. When Nineveh was threatened with destruction, to avert the calamity a fast was proclaimed, and the order given, "Let neither man nor beast, herd nor flock, taste anything; let them not feed nor drink water." Among heathen philosophers and religious people fasting was reckoned a duty—markedly so by the Pythagoreans, who lived a life of constant asceticism, abstaining always from flesh and fish, and at times from food altogether. The nations of the East and the Indians of North America are alike exceedingly severe in this respect. The Mohammedans keep as an annual fast their ninth month, Ramadan; during every day of this month, from sunrise to sunset, they eat nothing, drink nothing, and give up the solace of their pipe and every other usual indulgence. Their months being lunar, each in the course of thirty-three years occurs in every season. When the Ramadan happens in summer, the long hot days are exceedingly trying to those who must labor. The Jews from their earliest existence have observed stated and special fasts, national and private. Under the law, as first given, there was but one day imposed on the nation—the great day of the Atonement. In the course of time four other days were added in commemoration of sorrowful events in Jewish history. These days, especially the first, have been always, and are now, observed with great rigor: no food, no water, is allowed to pass the lips, not even for the rinsing which, on first rising, must always make clean the mouth before the pronouncing of God's name; even the swallowing of the saliva is carefully avoided. The fast lasts from sunset, when the Jewish day begins, until the shining of the stars the night after. Besides the public fasts, there were and are many observed by individuals in consequence of vows, or because of personal cause for affliction, or by way of discipline. The Pharisees fasted statedly twice in the week—Monday and Thursday. These fasts are not all of equal severity.

Under the New Testament there is no fast-day appointed by the Lord or by his apostles, nor does the practice rest upon direct command from them. It is even clear that Jesus imposed no special abstinence on his disciples, but it is also clear that he assumed that this exercise would not be neglected by any who desire the rewards given by God. He gave directions for fasting, for the shunning of hypocritical show, saying, "When ye fast be not of a sad countenance," etc., and by his example he taught the duty. It may be said that he thus taught and acted as a Jew. But when it was objected that his disciples did not fast as did those of other Jewish teachers, he gave as a reason why they did not that so long as he was with them the signs of sorrow were not expedient; and he added that the time would come when they should fast, referring to a time after the fulfilling of the law. If the apostles gave no rule on the subject, there is no room to doubt as to their practice. One reference is sufficient. In Acts xiii. it is said that as certain prophets and teachers at Antioch "ministered to the Lord, and fasted, the Holy Ghost said, Separate Barnabas and Saul for the work whereunto I have called them. And when they had fasted and prayed, and laid their hands on them, they sent them away."

It is not so stated in the New Testament, but it is probable that from its first recurrence the day of the crucifixion was observed as a day of humiliation, as it has been through the many centuries since. It is certain that rules were soon laid down touching this and other seasons of bodily mortification. Wednesday and Friday in every week were kept as such, and early writers who speak of these days of abstinence refer the observance to apostolic usage. The duty of bodily mortification at times of repentance or humiliation or of special spiritual exercises (for fasting does not of necessity imply sorrow) is recognized, it is believed, in this day by all classes of Christians without exception. There are some bodies of believers who have rejected the seasons so long observed, but yet these, on what they deem proper occasions, appoint days to be kept by all their members. Even the Puritans of New England had their yearly fast-day.

In the West, the churches of the Roman obedience, together with the Church of England, impose as stated fasts, first, Lent, the *spring* fast, beginning with Ash Wednesday in the seventh week before Easter, and counting forty days, Sundays being excluded. This long fast is of very early observance, but the time of its commencement and the period of its duration were not always the same, it being an expansion of the observance of the time of the passion of our Lord. As now kept, Lent was fixed by St. Gregory the Great in the sixth century. Second, the Ember Days, which are Wednesday, Friday, and Saturday preceding the four quarterly seasons of ordination. It has been already shown that in apostolic days fasting preceded ordination. The name is variously accounted for: probably it is a corruption of the Latin name for the seasons—*quattuor tempora*, or *tempora*. Third, the Rogation Days, the three preceding Ascension Day. This fast is not older than the close of the fifth century; it was first instituted in Vienne in France, to accompany a season of special rogations (petitions) that God would withdraw certain temporal chastisements. It was probably fixed because of its being a meet introduction to a great festival. Fourth, every Friday, this day being the weekly commemoration of the crucifixion, even as the first day, the Lord's Day, is a joyful remembrance of his resurrection. Fifth, the vigils on the eves of certain great festivals. At one time these vigils were literally kept as watches, the whole night, or a part, being spent in devotions in the churches. They are not so kept now. Advent, the four weeks before Christmas, bears some analogy to Lent, but its Wednesdays and Fridays are alone kept as fasts. The Protestant Episcopal Church in the U. S. follows the Anglican rule, excepting that vigils are not imposed, though in the new Standard (1892) recognition of the "eves" or "vigils" is found. In the English and American prayer-books the "Table of Fasts" comprises Ash Wednesday and Good Friday, while the "other days of fasting on which the Church requires such a measure of abstinence as is more especially suited to extraordinary acts and exercises of devotion" are:

I. The forty days of Lent.

II. The Ember Days at the four seasons, being the Wednesday, Friday, and Saturday after the first Sunday in Lent, after the Feast of Pentecost (Whitsunday), after Holy Cross Day (Sept. 14), and after St. Lucy's Day (Dec. 13).

III. In the Roman Catholic Church Fridays, outside of the above-mentioned fasting-seasons, are simply days of abstinence. The observance of the Rogation fast has varied greatly, and has generally ceased.

The rule of the Orthodox, the Armenian, and other churches of the East is nearly like that of the Western, having the same origin, that of the usage before the schism, but in some details they differ—e. g., in the Holy Orthodox Church on Aug. 1 begins the fast of the Mother of God, which lasts until the feast of her repose—fourteen days. It is to be observed, however, that in the East the strict idea of a fast is preserved to a greater extent than in the West. From earliest times a distinction in food was recognized, and allowance made for those who through bodily weakness could not wholly abstain. To whatever due, it is a fact that in the West the rules of fasting have always been more lenient than in the East. Very few of the days spoken of as fast-days are strictly such; they are days of abstinence, when less food and of a coarser character is taken. In the Holy Orthodox Church 266 days in the year are kept as fasts with scrupulous fidelity.

A practice so universal as that of fasting must be based on some necessity of man. Nevertheless, the objection is sometimes heard that it tends to spiritual pride and formalism. This must be granted, but abuse is no argument against due use. A Christian, who knows that his Lord joined together prayer and fasting, can hardly advance the objection. It is also objected that health is frequently injured by religious fasting. It may be so. But on the other hand, it can admit of no doubt that in an age and country particularly luxurious a stated abstinence from food, a weekly putting aside of self-indulgence, and supporting the body on plainer, less attractive food, would go far toward freeing men from many of the evils that wait on appetite. See FASTING. Revised by WILLIAM STEVENS PERRY.

Fast Freight Line: an organization for prompt delivery of through freight. It has two forms, the incorporated or non-co-operative one, which is very much like an express company, making contracts on its own account with the shippers and being responsible for the goods received. It differs from an express company chiefly in handling business in larger bulk, and not occupying itself with the collection and delivery of parcels. The more common form of freight line, known as the co-operative line, is not a company at all, but an arrangement between connecting roads for reporting car mileage to one another and tracing the responsibility for loss or damage of goods. Most freight lines are of this kind. They have the advantage, as compared with the incorporated line, of allowing no opportunity for inside rings to make unfair profits; they have the disadvantage of giving the shipper less security for responsible treatment, inasmuch as he is dealing with a number of different railroads instead of a single incorporated company.

A. T. HADLEY.

Fasti [Lat. (sc. *di'es*), court-days, liter., lawful days, plur. of *fas'tus*, lawful, deriv. of *fas*, divine right, law, deriv. of *fa'ri*, speak]: the court-days or festival-days of the ancient Romans. In accordance with the derivation, *dies fasti* were days on which it was allowed to speak, hence days on which judgment could be pronounced, on which courts could be held—court-days. A *dies nefastus* therefore denoted the opposite, and *dies nefasti* were esteemed unlucky days. To the *dies fasti* belonged the *dies comitiales*; to the *dies nefasti*, the *dies religiosi*, which were considered days of evil omen. The institution of these days is ascribed to Numa Pompilius, and belongs therefore to the earliest days of Rome. Their order or succession was long known only to the priests, who thus acquired great political power, until Cn. Flavius made it public about 304 B. C. From this time onward the lists of the *dies fasti et nefasti* received more particular attention, and contained, gradually enlarged and perfected, an accurate description of the whole year, according to its months, with exact specification of the *dies fasti*, *dies comitiales*—festivals and holidays, days appointed for the celebration of public games, etc. Thus they assumed the form of the later calendars or almanacs. As they were still, notwithstanding the care taken in their preparation, unavoidably inaccurate and imperfect, we are told of Cæsar "fastos correxit," etc. As the fasti or calendaria of ancient Rome were engraved on stone and set up in public places, remnants or fragments of such records, more or less complete, have been preserved and put together, in order to produce as perfect a representation as possible of one of these ancient Roman calendars or almanacs. If the ordinary fasti or calendaria are valuable as affording a correct knowledge of the Roman year, much more important are those which Livy calls "fasti consulares," and which, because they were set up on the Capitoline, are also called Capitolini. The Fasti Capitolini contain lists of the annual consuls, of the censors, dictators, magistri equitum, and also of generals who celebrated triumphs (*fasti triumphales*) and a record of the services for which a triumph had been granted. Of such Fasti Capitolini important fragments, discovered in 1547 at Rome, are extant. For further particulars, see Pauly's *Real-Encyklopädie*, etc.

Fasti is also the title of a well-known but unfinished poem by Ovid, the subject of which is the Roman festivals —the festival-calendar. It may be regarded as "a poetical year-book or companion to the almanac, having been composed to illustrate the Fasti published by Julius Cæsar," who corrected and entirely reformed the calendar.

Fasting: properly, the total abstinence from food; commonly, however, a restricted diet in which only certain articles of food are excluded because of religious or other motives.

The effects of fasting upon the organism are determined by the kind of foodstuffs that are withheld and the degree of abstention, the state of the body and mind, the species of animal, the length of time the fast continues, the sufficiency of the supply of water, and certain attendant conditions. A study of dietetics teaches that the human organism absolutely demands for its healthy maintenance certain kinds of foodstuffs, whereas others which enter largely into everyday diet and are of great nutritive value are merely of incidental importance. Albuminous substances are a necessity because it is only by their means that the demands for nitrogen are supplied, and were these entirely withheld starvation would as inevitably ensue, even though an abundance of other food be taken, as when there is total abstinence. On the other hand, starchy and saccharine matters might be rejected without causing physical want, because they are capable of being replaced as nutritive elements by fat and partly by the albuminous materials. Similarly may the fats be replaced. Abstention from single articles of food does not affect the nutritive condition of the body provided that their dietetic values are replaced by other foodstuffs. In certain morbid states of the system, as in the various forms of dyspepsia, mal-assimilation, diabetes, etc., the exclusion of certain articles of food often proves of great benefit.

When there is total abstinence for short periods of a day or two no important effects are observed save intense hunger, gastric distress, headache, weakness, and a feverish condition; but when practiced for prolonged periods other phenomena of a marked character are noted. In order that these may be understood it is necessary to bear in mind that the vital processes depend for their activity upon energy which is continually being supplied by means of chemical processes, whereby the complex compounds which are ingested as food undergo decomposition into simpler substances. When food is insufficient to supply the demand the organism consumes its own tissues (autophagy), which results in a loss of body-weight and an enfeeblement of all the vital processes.

The earliest symptoms usually observed in enforced fasting, apart from those mentioned in the preceding paragraph, are irritability, lassitude, a slight increase in the frequency of the pulse and respiration (especially upon any exertion), a decrease of the temperature of the body, constipation, and a diminution in quantity and increased acidity of the urine. There then appears a tendency to delirium, particularly noticed and of a serious character in cases of individuals who are deprived of food because of shipwreck or similar accident; but in voluntary fasting it is seldom of much moment and soon passes off. The body loses weight from day to day with considerable regularity; the stools become scant and tarry; nausea, flatulence, and colic are apt to be more or less annoying; the blood and tissues lose more and more of their water, and consequently the blood becomes thicker and the tissues less moist; the white blood corpuscles gradually and after a time ultimately disappear; the red corpuscles of the blood do not seem to be affected in their relative numbers, although apparently increased owing to the loss of water from the blood; but in prolonged fasts large numbers of them are small and imperfect. Albumin and all matters in the blood that are available for nutritive material for the tissues are diminished. The skin loses its elasticity and becomes pale, harsh, dry, and shriveled; the body exhales a peculiar fetid odor. Wasting of the body and enfeeblement of all the vital processes continue until the loss of weight in the adult reaches about 40 per cent. of the original, in the young about 20 per cent., when death occurs from exhaustion.

In the report of Mr. Robins of the forty days' fast of the professional faster Succi, there is probably the most satisfactory account of any on the subject. Succi is a native of Italy, 5 ft. 5½ in. tall, aged 27, slightly built, and of sallow complexion. He claims to have accomplished thirty-two fasts previous to the forty days' fast alluded to, in which he abstained from food for periods varying from twenty to thirty days. Before beginning the forty days' fast he ate a fair luncheon, and from this time to the end of the ordeal was kept under rigid vigilance to prevent deception. Robins states that from the first day to the last Succi did not develop a single alarming symptom nor experience any great amount of discomfort. Even during the first few days, when the pangs of hunger might have been expected to assert themselves most acutely, he made no complaint, but in reply to questions said he felt very comfortable. The change in his condition from that of a well-formed though slight man to one of extreme emaciation, though very great, was almost uniform from day to day. There was not at any time any irregularity in the heart's action, although his pulse was a little more frequent. He smoked usually one or two pipes a day and occasionally a cigar or cigarette. During each day he took a small quantity of an "elixir," on an average of less than 60 drops per diem, in doses varying from 5 to 20 drops in water. He took this as a sedative to the stomach, and to relieve slight colic and flatulence, from which he suffered at times. It resembled chlorodyne in composition and effects, and did not contain coca or anything of a nutritive character. During his fast he drank filtered water, Kaiser-brunnen alkaline table-water, and Hunyadi-janos (purgative) water. The total quantities were: water, 535½ oz.; Kaiser-brunnen, 354 oz.; and Hunyadi, 33 oz. Total, 922½ oz., or about 57½ pints—less than a third of what the average individual would consume under ordinary circumstances. During the first ten days Succi lost 16 lb. 5 oz.; during the first twenty days, 22 lb. 15 oz.; during the first thirty days, 28 lb. 12 oz.; and during the forty days, 34 lb. 3 oz.—the total loss of weight being 26·55 per cent.

The amount of urea eliminated was diminished during the first week to 3·04 grains per pound of body-weight per diem (the normal being 3·5 grains); during the second week to 2·12 grains; during the third week to 1·66 grains; during the fourth week to 1·5 grains. During the fifth week it rose to 1·79 grains, and during the last four days the average was 2·10 grains. The increase in the amount of urea during the fifth week indicates the beginning of what may appropriately be considered the second stage of autophagy. During the first stage the energy of the body is derived almost solely from the consumption of nutritive substances which are stored in the blood and various structures; and subsequently from the consumption of fat. As soon as the fat has largely disappeared the muscular and other albuminous tissues are fed upon to a relatively greater extent, with the consequent increase in the amount of urea. With the second stage the danger line is reached, and each day adds increasingly and disproportionately to the peril, because of the gradual destruction of the more important of the vital structures.

During the progress of autophagy the various tissues do not suffer alike, some being preyed upon earlier and consumed to a greater degree than others. The first portions used are nutritive substances which are stored in the different structures, such as sugars, glycogen, loose particles of fat, albumin, etc. As soon as these are gone the solid parts suffer, first, chiefly adipose tissue, and after its practical disappearance the muscular substance especially. Consequently, during the first stage the loss of weight is mainly due to the disappearance of fat, whereas during the second stage the loss is chiefly due to the using up of the nitrogenous structures. During the entire period of fasting there is a steady loss of weight owing to a loss of water.

In cases of death from starvation the blood is increased in specific gravity, and contains less water, albumin, corpuscles, and substances available as nutritive materials; fat has almost entirely if not entirely disappeared; the liver is dark and much reduced in size; the muscles are greatly wasted and, together with the other tissues, greatly lacking in water. All of the structures are wasted.

The ability to withstand the total abstinence of food varies in different individuals, and is materially affected by many attendant circumstances; consequently, the effects vary in different cases. As a rule, death occurs within a period of three to three and a half weeks, but there are many cases on record in which death ensued much sooner, and, on the other hand, in which it was not noted until forty to sixty days. Claims have been made, but never properly substantiated, that total abstinence has extended over many months or even years, but sixty days is the longest period that at present can be accepted as having been demonstrated. Age exercises a material influence; the middle-aged withstand fasting better than the young or old; infants die in a few days, and young children in a week or ten days.

The lower animals, as a rule, are less severely affected by fasting than man. A pig has been known to fast for 160 days, and snakes and certain other cold-blooded animals for periods of a year or over. Cats, horses, and mules live for over three weeks, and dogs and wolves for two months. Rabbits live for two or three weeks, and birds, Guinea pigs, and rats for about a week. During hibernation animals exist for months without food or drink, but in this condition the mind is in abeyance and the general state of vitality is exceedingly low, almost on the border of death, and, as a consequence, there is relatively little consumption of the tissues.

Life is prolonged by a sufficient supply of water, and by mental and physical quiet; and in man and warm-blooded animals by high ambient temperature and abundant clothing to prevent the loss of bodily heat, and thus diminish the consumption of the tissues. Fasting as observed in the insane, hysterical, and fanatics is usually exceptionally well borne because of the peculiar mental states. In instances of enforced fasting, as in the case of the shipwrecked, entombed miners, etc., the terrible mental strain adds greatly to ill effects due to the want of food, and commonly in these unfortunates the mind is soon unbalanced. When water is also withheld death occurs about one-third sooner. When drinking water is not to be had great relief has been experienced and life prolonged by placing wet cloths to the body or by immersing the feet, etc., thus allowing absorption of water through the skin.

Auselmier has shown in the results of experiments on dogs that if a certain amount of blood is drawn from them when they are subjected to inanition and given to them as a food the daily loss of temperature is less, life is prolonged, and emaciation more complete, so that the loss of weight may reach 60 per cent. of the initial weight. In fat subjects the emaciation reached 60 per cent., in medium 50 per cent., and in the young 40 per cent. Animals live one-half longer than when this was not practiced. The value of this method, which is spoken of as "artificial autophagy," has been illustrated in cases of starving men.

In the restoration of diet after prolonged fasting the administration of food should be begun by giving small quantities of beef tea, milk, diluted spirits, rice broth, or similar very light diet; after twenty-four hours, corn starch, rice, mellow apples, orange juice, etc.; then gradually increasing the number of articles from day to day as indications suggest. In instances in which absolute freedom of diet has been permitted, the most serious results have followed. See FOOD. EDWARD T. REICHERT.

Fasting, faas'ting, CLAUS: Norwegian poet and critic; b. in Bergen, Oct. 29, 1746. He studied divinity, and took his theological examination at Copenhagen in 1766; but his tastes were for music and literature. From 1770 to 1777 he resided in Copenhagen, where he became a distinguished member of the Norske Selskab. His tragedy *Hermione* (1770) shows the influence of Voltaire. He was more important as a critic and the editor of critical journals (1773, 1775-76) than as a poet or a dramatist. From 1777 till his death (Dec. 24, 1791) he lived in Bergen. His drama *Aktierne* appeared in 1788. A selection from his works was edited by L. Sagen: *Udvalg af Claus Fastings Skrifter med Bidrag til hans Biografi* (Bergen, 1837). G. L. KITTREDGE.

Fastnet Rock Light: See the Appendix.

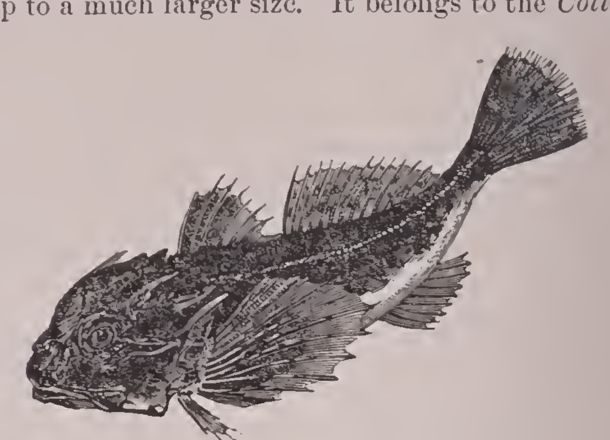
Fat: See HISTOLOGY and FATS.

Fata Morgana, faa'taa-mōr-gaa'naa [Ital., the Fairy Morgana, the phenomenon being regarded as the work of a fairy (*fata*) named *Morga'na*. *Fata* < Low Lat. *fata*, a goddess of fate, a fairy > O. Fr. *fee, fae* (> Fr. *fée*), whence Eng. *fay*, fairy]: a remarkable and singularly beautiful effect of mirage, occasionally observable in the Sea of Reggio, Straits of Messina, between Sicily and Calabria. It presents a series of magnificent architectural structures and landscape views, embracing columns, arches, towers, castles, palaces, trees, avenues, and wooded plains, with crowds of moving men and animals, all constantly varying and assuming new aspects, and in certain conditions of the atmosphere becoming resplendent with prismatic colors. There can be no doubt that these images are derived from objects on the shore, their singular forms and transformations being the result of extraordinary refractions in the atmosphere (for the explanation of which see MIRAGE).

Fate [M. Eng. *fate* < O. Fr. *fat* < Lat. *fa'tum*, thing spoken, decree, fate, neut. perf. partic. of *fa'ri*, speak: Gr. φάναι, speak]: inevitable destiny. The belief in such a destiny has various forms. The old Chaldaic or astrological fatalism looked upon the visible heavens as the book of this destiny, and found all things necessarily prefigured in the positions of the stars. The old Stoical fatalism considered the rise and the decay of the world as controlled by an absolute necessity, but while this necessity, with them, was a fate (εἱμαρμένη), which determines, it was also a providence (πρόνοια) which governs all things. The fatalism of the Greek dramatists made all events fixed under the control of Dike and Nemesis, Justice and Retribution. Mohammedan fatalism regards all things, great and small, as so inexorably predetermined from the foundation of the world that no accident is possible, and any attempted defense against danger is futile. Pantheistic fatalism considers the infinite substance which it calls God to be developed in space and time by a procedure so changeless that things extended or things thought are equally necessary; and which not only destroys all freedom of the will, but obliterates all distinction between good and evil. The modern philosophical conception of fate is that of a blind causality undirected and undetermined by any conditions.

Fates, The (transl. of Lat. *Par'cæ*, Gr. Μοῖραι, the goddesses of fate, liter., the distributers, or dividers): in the Greek mythology, three goddesses who ruled the fates of men and all thing. They are generally named Clotho, who spins the thread of life; Lachesis, who marks off the allotted span; and Atropos—the inflexible—who cuts the thread. Their genealogy and the whole mythus are quite variously given in different authors. The Homeric poems speak usually only of one Moira, and the personification is not complete; no particular appearance of the goddess, no attributes, and no parentage are mentioned. Nor is the Homeric Moira an inflexible fate to which the gods themselves must bow; on the contrary, Zeus, as the father of gods and men, weighs out their fate to them. With Hesiod the personification of the Fates is completed, but they are still represented as depending on their father Zeus, and subject to his commands. And it was not until the time of Æschylus that they appeared as the divinities of fate in the strict sense of the word, independent of the Olympic gods, the messengers of the eternal necessity to which even the gods must bow. They are generally associated with the Erinnyes, who inflict the punishment for evil deeds, and they are sometimes called their sisters.

Father Lasher, or **Lucky Proach**: a marine fish (*Acanthocottus bubalis*) of the European coasts, from 6 inches long up to a much larger size. It belongs to the *Cottidæ* or



The father lasher.

sculpin family, its head is covered with spines, and it has a repulsive aspect. It can live a long time out of water, and, though regarded with aversion it affords a palatable article of food.

Fathers, Apologetic: See APOLOGETICS.

Fathers (of the Church): the distinguished earlier laborers in the Christian Church. (See APOSTOLIC FATHERS.) The Roman Catholic Church distinguishes between Church Fathers, Church teachers, and Church writers. The Church teachers are men of acknowledged orthodoxy, authorities for the doctrines of the Church, while the Church writers are of less, or even doubtful, authority. The greatest of the Church teachers are also Church Fathers. Such were Athanasius, Basil the Great, Gregory of Nazianzen, and Chrysostom in the Oriental Church—Jerome, Ambrose, Augustine, and Gregory the Great in the Church of the West. Thomas Aquinas and Bonaventure may be named as Church teachers who were not Fathers, and Tertullian in his second era and Origen as Church writers who were not Fathers according to the Roman definition, which includes orthodoxy. The line of Church Fathers is generally regarded by Protestant theologians as terminating with the eighth century (John of Damascus in the Greek, Gregory I. in the Latin Church); the Roman Catholic writers extend it to the thirteenth, or even to the Council of Trent. The scientific treatment of the matter contained in the writings of the Fathers is embraced in Patristics, while their lives and the topics which are related to the externals of their works come under the head of Patrology. This distinction, however, is not always observed. The Fathers are of great value in the history of biblical interpretation, the history of dogmas, creeds, rituals, the constitution of the Church, and indeed in every part of historical theology; nor is there any part of theology in which they may not be made highly useful. In the greatest internal struggles of the Church the importance of the Fathers as witnesses or as authorities has been recognized on both sides, as in the Reformation, and in the nineteenth century in the controversies of the Anglican Church. (The principles to be observed in interpreting the Fathers are stated in Krauth's *Conservative Reformation*, 726, *seq.*) Next to the Apostolic Fathers in value are the Apologists, or Apologetic Fathers (see APOLOGETICS); the Alexandrians, Clement and Origen; the Nicene and Post-Nicene Fathers: Eusebius, Athanasius, Gregory of Nyssen, Chrysostom, Augustine, and Jerome. (All the earlier writers on patrology, beginning with Jerome, were edited together by Fabricius, 1718.) The greatest laborers in the issue of editions of the Fathers have been the BENEDICTINES (*q. v.*; see also BENEDICTINE EDITIONS OF THE FATHERS). Next to them have been the Anglican divines. The most recent interest in patristics in Great Britain has been shown in the issue of translations of the Fathers. In the Roman Catholic Church, among the names illustrious in patrology are Bellarmin, Oudin, Du Pin, Le Nourry, Tillemont, Möhler, Hefele, Alzog, Nirschl; in the Protestant churches of the Continent, Scultetus, Walch, Danz, Neander, Otto, Harnack, Zahn; in Great Britain, Cave, Cureton, Routh, Pusey, and Lightfoot. Among the editions of the collected writings of the Fathers, the most complete are De la Bigne's (17 vols., 1654); the Lyons *Maxima Bibliotheca* (27 vols., 1677); Cailleau and Guillon (148 vols., 1829, *sqq.*); Migne (1844–66; new ed. 1878, *sqq.*). The last is, *in bulk*, the greatest of the collections, and embraces the Greek Fathers in 167 volumes and the Latin Fathers in 222 volumes. It is continued by Abbé Horoy, and is to be brought down from 1216 (Innocent III.) to the Council of Trent. The very numerous editions of particular Fathers are mentioned under their names. Books of selections, Rösler, Augusti, Orelli, Philo, Oehler. English editions of the principal Fathers: *The Oxford Library of the Fathers* (48 vols., 1837–85); *The Ante-Nicene Library*, by Roberts and Donaldson (24 vols., Edinburgh, 1866–72; 8 vols., New York, 1886); *Nicene and Post-Nicene Library*, first series ed. by Schaff (14 vols., New York, 1886, *sqq.*), containing the works of Augustine in 8 volumes and the works of Chrysostom in 6 vols.; second series by Schaff and Wace (14 vols., New York and Oxford, 1890, *sqq.*). Best edition of the Apostolic Fathers in Greek and English by Lightfoot (London, 1891). Patristic manuals in German by Alzog (4th ed. 1888) and Nirschl (3 vols., 1885). The standard English work on patristic biography and literature is Smith and Wace's *Dictionary of Christian Biography* (1882–88). Revised by PHILIP SCHAFF.

Fathipur′: the capital of the district of the same name, Allahabad division, Northwest Provinces, in British India (see map of N. India, ref. 6–F). The town is of both commercial and military importance. Pop. 20,000.

Fathom [M. Eng. *faðme* < O. Eng. *fæðm*, the outstretched arms, fathom: O. H. Germ. *fadam* > Mod. Germ. *faden*, thread < Indo-Eur. *pat-*, spread out, extend; cf. Lat. *pate're*, be open, extend]: originally the length which a man can measure by extending both his arms. It now denotes a measure equal to 2 yards, or 6 lineal feet, and is chiefly employed in nautical measurements. It is the unit of measure in soundings, and is employed in the measurement of cables, etc. The early colonists of the present U. S. reckoned the Indian wampum chains, then current as money, in fathoms.

Fatigue: See MUSCLE-SENSE.

Fatigue of Materials: the injury done to materials by stresses which exceed the ELASTIC LIMIT (*q. v.*). For instance, if the ultimate strength of a bar of wrought iron is 55,000 and its elastic limit is 25,000 lb. per sq. inch, a single application of a load will not cause rupture until the 55,000 lb. per sq. inch is reached. But if stresses be often applied which exceed the 25,000 lb. per sq. inch, the molecular structure is altered, the iron becomes brittle, and finally rupture will occur under a stress of perhaps 30,000 or 40,000 lb. per sq. inch. It is hence a fundamental rule that the materials in permanent structures should not be strained beyond the elastic limit, and the factor of safety should be selected with this in view. The experiments of Wöhler, conducted for the German Government about 1870, have proved of great value in establishing some of the laws governing the fatigue of materials. He showed that in the case of repeated stresses, the greater the range of these stresses the less is the unit-stress which is finally required to produce rupture, and also that a range of stress from tension into compression, or *vice versa*, produces rupture with a less number of repetitions than for one kind of stress alone. Engineers make allowance for the fatigue of materials due to repeated stresses by means of formulas deduced by Weyrauch, Launhardt, and others. See Weyrauch's *Iron and Steel Constructions* (1875) and Merriman's *Mechanics of Materials* (1892). See also STRENGTH OF MATERIALS.

MANSFIELD MERRIMAN.

Fats: in the common sense, those unctuous parts of animal and vegetable bodies secreted in the cellular tissues and separable therefrom by fusion at a moderate temperature. The animal fats do not differ chemically from those of vegetable origin. Both are definite compounds of certain fatty acids, chiefly oleic, stearic, and palmitic acids, with a basic substance called GLYCERIN (*q. v.*), which belongs to the class of alcohols. The fats are, as a rule, nearly insoluble in water, but dissolve readily in ether, which is their proper solvent. They are also soluble in naphtha, benzine, and the oils from coal; in oil of turpentine and other essential oils; bisulphide of carbon, chloroform, fusel oil, etc. They are scarcely at all soluble in cold ordinary alcohol. In absolute alcohol they dissolve much more readily than in weaker alcohol, and especially with the aid of heat. See FOOD.

The fats stain paper permanently and are not volatile by heat, a high degree of heat being required to make them boil. They distill over at a high heat, but not without complete, or nearly complete, decomposition, and the evolution of a substance of a pungent, disagreeable odor, irritating the eyes, and known as *acrolein*. Those fats which are fluid at ordinary temperatures are called oils. All the fats burn with a bright flame and with little smoke.

The chemistry of fats was first cleared up by CHEVREUL (*q. v.*), who showed that they belong to the class of compounds known as ethereal salts, or compound ethers. (See ETHER.) Most fats are mixtures of three compounds, olein, stearin, and palmitin, the hard fats being chiefly stearin and palmitin, and the soft fats olein. The hard fats are beef fat, mutton fat, human fat, wax, spermaceti, etc.; the soft fats, hog's lard, butter, etc., which are greasy at ordinary temperatures; while the liquid fats, or oils, are fluid at ordinary temperatures. When a fat is boiled with a caustic alkali, or treated with lead oxide, or superheated steam, it is decomposed, yielding glycerin as one of the products, and a mixture of acids or salts of acid. When the decomposition is effected by an alkali, the products are glycerin and a soap. (See SOAP.) Hence this process is called saponification. Lead oxide forms glycerin and "lead plaster." Steam forms glycerin and the acid or acids which were combined with the glycerin in the fats.

The researches of Berthelot have demonstrated the accuracy of Chevreul's views by the synthesis of fats from the union of fatty acids with glycerin, and the separation of one, two, and three molecules of water. See GLYCERIN, OILS, and SOAP.

The memoirs of Chevreul on the fatty bodies are among the most remarkable examples of a chemical research which has remained almost without important addition or change from the labors of subsequent investigators.

Revised by IRA REMSEN.

Fatty Degeneration: in pathology, a condition in which the minute structural elements of the tissues of living organisms are gradually replaced by fat globules. In man this diseased condition has been observed in nearly all the tissues.

In the great closed glands of the fœtus, which disappear after birth, and in the corpus luteum of the ovary, fatty degeneration is a normal process. In the liver, it is merely an excess of the normal fatty element contained in the acini, which, however, encroaches upon the organized elements of those structures, and becomes a true fatty degeneration. It also attacks the muscles, and especially the heart; the bones (in some forms of *mollities*), the brain (yellow softening), the cornea (*arcus senilis*), and the kidney in many cases of so-called Bright's disease. The fatty degeneration of the heart unaccompanied by valvular disease is very difficult to detect, even by the trained diagnostician. When suspected, a quiet life and a nourishing but not too stimulating diet, with the judicious use of tonics and iron, are to be recommended. For the disease there is no cure known.

Revised by WILLIAM PEPPER.

Fatuity [from Lat. *fatu'itas* (> Fr. *fatuité*), deriv. of *fa'tuus*, insipid, senseless, foolish]: a state of mind characterized by absence or great deficiency of the will and the intellect, and by apathy with regard to those things which usually arouse the feelings and impulses. If congenital, it constitutes complete or partial idiocy. When it is associated with, or consequent upon, acute disease, it has no significance except as a symptom of that disease; while if it be long continued, obscure in its origin, and progressive in character, it is almost certain to result in dementia, one of the most hopeless forms of mental disorder.

Fau′ces Ter′ræ [Lat., jaws of the land]: projecting headlands or promontories, including arms of the sea, as, e. g. bays, creeks, lakes, basins, harbors, rivers, etc., where the tide ebbs and flows. In England the general rule is that such bodies of water, as far as the point to which the flow of the tide extends, and unless they are within the body of a county, are under the jurisdiction of the courts of admiralty. In these exceptional instances the common-law courts exercise exclusive jurisdiction, except in a few classes of questions to which admiralty powers have been extended by statute. A stream is said to be "within the body of a county" (*infra corpus comitatus*) when a person standing on one shore can see what is done upon the other. In the U. S. the admiralty jurisdiction is not confined to tide waters, and is not excluded from waters "within the body of a county," but extends over the Great Lakes and over all rivers, etc., capable of navigation for practical commercial purposes. The whole subject is fully developed in the decisions of the Supreme Court of the United States, which will be found in the volumes of reports.

GEORGE CHASE.

Fauche, fōsh, HIPPOLYTE: Sanskrit scholar; b. at Auxerre, France, in 1797. His translations of the *Râmâyana* (9 vols., 1854–58) and the *Mahâbhârata* (7 vols., unfinished, 1863–67) are among his most important works. He published an original tale and some poems. D. at Juilly, Seine-et-Marne, 1869.

Faucher, fō'shā', LÉON: state minister, political economist, and financial writer; b. in Limoges, France, Sept. 8, 1803; was in youth a designer of embroidery patterns, and then a teacher; wrote for the *Courrier Français* and the *Revue des Deux Mondes*. In 1846, in the French Chamber of Deputies, acted with the Left; Minister of the Interior from Dec., 1848, to May, 1849, and from Apr. to Oct., 1851; was liberal but not republican in politics. *Studies on England* (1845) and *Miscellanies of Political Economy and Finance* (2 vols., 1856) were his productions. D. at Marseilles, Dec. 15, 1854, having always declined office under the Emperor Louis Napoleon.

Faucher de Saint-Maurice, Le Chevalier NARCISSE HENRI EDOUARD, LL. D.: Canadian journalist; b. at Quebec, Apr. 18, 1844; educated there and at the College of Ste. Anne de la Pocatière. He went to Mexico in 1864; became a captain in the army of Maximilian, and subsequently aide-de-camp to Gen. Viscount d'Hurbal. He served through the war, and for his services was created a Knight of the Imperial Order of Guadeloupe; received the medal of the Mexican campaign from Napoleon III., and the military medal for valor and integrity given by the Emperor Maximilian. He returned to Canada in 1866; has since edited *Journal de Quebec* and *Le Canadien*, and is now (1893) president of the Press Association of Province of Quebec. He was created a chevalier of the Legion of Honor, France, in 1881, and is a member of various learned societies. For fourteen years he was clerk in the Legislative Council, Province of Quebec; a representative in its Legislature 1881–92, and is (1893) president of the Quebec Oriental Railway Company. Among his works are: *À la Brunante, De Quebec à Mexico* (2 vols.), *Choses et autres, De Tribord à Babord, Cours de Tactique, Deux ans au Mexico, Les Iles*, and *En Route*.

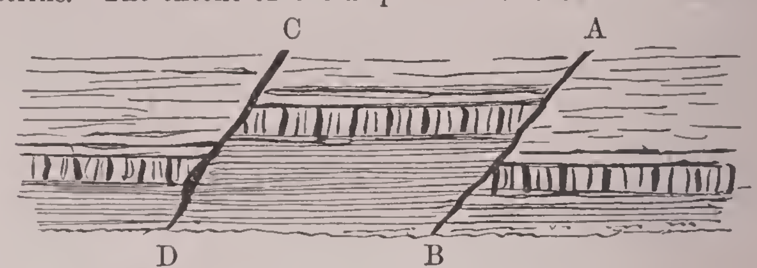
NEIL MACDONALD.

Fau'cit, HELEN (*Lady Martin*): actress; b. Oct. 11, 1819; made her *début* at Covent Garden, London, Jan. 5, 1836, in the character of Julia in *The Hunchback*, in which she achieved great success and at once took high rank as an actress, becoming a leading member of Macready's companies during the production of his Shakspearean revivals. She was the original representative of the heroines in Bulwer's *Lady of Lyons, Richelieu*, etc., and in many other plays of different authors. In 1851 she married Theodore Martin, but continued to appear on the stage at intervals. In 1880 her husband was knighted by Queen Victoria for his literary attainments. Lady Martin's last appearances were at Stratford-upon-Avon in Apr., 1879, when she played Beatrice at the opening of the Shakspeare Memorial theater, and at Manchester when she played Rosalind for the benefit of the widow of an actor. D. Oct. 31, 1898.

Faulkner, fawk'ner, CHARLES JAMES: lawyer; b. in Berkeley co., Va., in 1805; received a collegiate education, and was admitted to the bar in 1829. In 1832–33 he was elected to the House of Delegates, in 1841 to the Senate of Virginia, in 1848 again to the House of Delegates, and in 1850 was a member of a convention to revise the constitution of the State; representative in Congress from Virginia 1851–60, when appointed minister to France by President Buchanan. He returned to the U. S. in 1861, was imprisoned, on suspicion of disloyalty, in Fort Warren, Boston harbor, and exchanged in December of that year for Hon. Alfred Ely. In 1874 was elected to Congress from West Virginia. D. Nov. 1, 1884.

Faulkner's Island: a small elevated island lying off the harbor of Guilford, Conn., in Long Island Sound. It is within the limits of New York, and has a lighthouse with a flashing light and a fog-bell; lat. 41° 12' 41" N., lon. 72° 38' 54" W.

Fault [readapted from M. Eng. *faut, faute*, from O. Fr. *faute* > Fr. *faute* < Low Lat. **falta*, deriv. of *fal'lere*, deceive, lack]: in geology, a displacement of rocks along a plane of fracture. The inclination of a fault plane is called its *hade*, and is counted in degrees from the vertical. The direction of a horizontal line lying in a fault plane is called its *strike*. The direction of the hade is the direction toward which the plane descends, and is at right angles to the strike. The extent of the displacement is called the *throw*



Ideal section showing normal and reverse faults.

of the fault, and oblique throw is distinguished from vertical throw. A fault of which the hade is directed toward the body of rock that has been relatively depressed is said to "hade to the downthrow," and is called a *normal* fault; a fault hading to the upthrow is called a *reverse* fault. A reverse fault of which the hade is great is called a *thrust* fault, or *overthrust* fault. A system of parallel faults with throw on the same side are called *step* faults. Fault planes are never planes in the mathematical sense, but are variously curved, the hade and strike continually changing. The bodies of rock on the two sides are not always in contact, but there usually intervenes a sheet of crushed material known as *fault rock*. The walls of a fault usually exhibit polish and fine striæ (*slickensides*), the striæ showing the direction of movement.

As related to mining, faults are interruptions in the continuity of ore-beds; as related to earth structure, they are incidents of orogenic dislocations whereby great masses of rock have been lifted higher or dropped lower than contiguous masses. Overthrust faults involve the horizontal crowding together of rock masses, and are associated with other evidence of such compression. Normal faults are associated with movements causing the affected bodies of rock to occupy greater horizontal space. The dimensions of faults exhibit great range. The throw may be measured by inches, by feet, or even by tens of thousands of feet. The linear extent may be a few hundred yards, a few miles, or even some hundreds of miles. See GEOLOGY and MOUNTAINS.

G. K. GILBERT.

Fau'na [from Low Lat. *Fauna*, a rustic goddess, sister of *Faunus*, but by analogy with *flora* (thought of as plur. of Lat. *flos*, flower), the word is thought of as a plural of *faunus*, a faun, with generalized meaning]: the assemblage of animals inhabiting any given locality, either in the present or past ages of the globe. In palæontology, however, it is sometimes used with more latitude, and is given to an assemblage of animals characteristic of a given period. Inasmuch as there are no very abrupt demarkations for any given region, the idea of a *fauna* is based, to a greater or less extent, on the forms combined in a central, or, as it is called, metropolitan district. Various combinations of animals are more or less characteristic of certain countries or portions of the earth's surface, many forms being limited by climatal or physiographical or unknown conditions.

Various names have been applied to these combinations, or to the areas of which these combinations are characteristic, different authors using the same term in different senses. The larger areas have been variously designated *realm, region*, or rarely, as by Louis Agassiz, *fauna*. The more limited areas have been called *region, district*, or *fauna*, this latter being the name adopted by Dr. J. A. Allen, who has devoted particular attention to the study and systematic arrangement of life areas. Fauna, then, is used in two different senses—1, as expressing the sum total of animals inhabiting *any* area or locality; and 2, less often as the designation of one of the life areas of the world. The consideration of the faunas of the respective regions of the earth is the subject of a particular branch of science, ZOÖLOGICAL GEOGRAPHY; and under that head the principles and facts involved will be treated, while the principal features of the geographical distribution of the various groups of animals—the subject of geographical zoölogy—will be presented in the articles on such groups.

THEODORE GILL.

Fau'nus: a Roman woodland deity, corresponding to the Grecian Pan, many of whose attributes were assigned to him. He possessed the power of prophecy, and his oracles were in the groves. A festival, named Faunalia, was celebrated in his honor by the country people. As a frolicsome wood deity, represented with the horns of a goat and the feet of a satyr, he was multiplied by the poets, and the Fauni or Fauns corresponded to the Greek satyrs. Poetic tradition represented him as an early King of Latium, son of Picus, grandson of Saturn, and father of Latinus.

Fauque de Jonquières: See the Appendix.

Faure, fōr, FRANÇOIS FÉLIX: President of France: b. in Paris, Jan. 30, 1841; was a merchant at Havre. During the Franco-German war he was chief of battalion of the Garde Mobile. He was several times elected to the Chamber of Deputies, and was Under-Secretary of State in the ministry of Commerce and of the Colonies in the cabinets of Gambetta (Nov., 1881–Jan., 1882), Jules Ferry (Sept., 1883–Mar., 1885), and Tirard (Jan. 5 to Feb. 16, 1888), and afterward Minister of Marine. He became President Jan. 17, 1895. D. in Paris, Feb. 16, 1899.

Faure, JEAN BAPTISTE: See the Appendix.

Fauriel, fō'rē-el', CLAUDE CHARLES: philologist and historian; b. at St.-Étienne, France, Oct. 21, 1772; nephew of the Abbé Sieyès. In 1830 a chair of Foreign Literature was founded for him in Paris. Among his principal works are a *History of Southern Gaul* (1836); *History of Provençal Literature* (1846); and *Popular Songs of Modern Greece*, with a French version (1825). D. July 15, 1844.

Fausset, ANDREW ROBERT: See the Appendix.

Faust, fowst, JOHANN, Dr.: a German magician who flourished during the first thirty years of the sixteenth century; generally supposed to have been a native of Knittlingen, in Würtemberg; b. about 1480; d. about 1538. His history is obscured by extravagant fiction, and it is impossible to state with certainty the place of his birth or decease. Regarding his existence there is undoubted testimony, and it is known that he spent some time at Wittenberg, at one time enjoying the association of Melanchthon. (See Scheibel, *Kloster*, ii. p. 14.) Conrad Gesner and Luther (*Tischreden*, p. 216) also make mention of him. Dr. Faust seems to have been a learned man who had studied magic and astrology, and, traveling about the country performing various feats, came to be regarded as a dealer in the black art, and one maintaining an intimate relation with evil spirits. The belief in witchcraft was universal in Europe in the Middle Ages, and nowhere did it prevail so universally as in Germany. A bull of Pope Innocent IV. (1243–54) declares that it having come to his ears that in parts of Germany persons forgetting or denying the Christian faith have dealings with the devil, he commands all such individuals to be seized and punished forthwith with loss of property and life; and soon after appeared a work on sorcery and witchcraft—the *Malleus Maleficarum*, or *Witch's Hammer*—which enjoyed the approbation of the theological faculty of Cologne. "Germany indeed seemed to live and breathe in an atmosphere of sorcery. The ground which Faith had lost Superstition made her own." Even the Reformers believed in witchcraft and in the bodily presence of the Spirit of Evil upon the earth. According to tradition, Faust enjoyed in his youth a large fortune, gave himself to a life of extravagance and licentiousness, and soon squandered his vast possessions. He then devoted himself to the study of magic at Cracow, determined to regain his wealth and enjoyments, and after a mastery of the secret sciences made a compact with Satan, according to which the latter was to serve Faust for twenty-four years, when the Evil One should possess the soul of Faust. The contract signed by Faust with his own blood contained the following conditions: "1. He shall renounce God and all celestial hosts; 2, he shall be an enemy of all mankind; 3, he shall not obey priests; 4, he shall not go to church nor partake of the holy sacraments; 5, he shall hate and shun wedlock." Mephistopheles, a devil "who liked to live among men," was given Faust as an attendant, and the two together roamed over the land, Faust enjoying every form of sensual pleasure, and performing magical feats never before performed, until at last the time arrived when the fatal debt was due, and Satan appeared in the most hideous form imaginable between twelve and one o'clock at night, and finished Faust's earthly career, bearing away with him the soul of the unhappy being. Such is the monstrously mythical form in which Faust's life appears in the popular tradition. Its aim evidently is to describe that tendency to sacrifice the future, however precious—nay, salvation itself—to immediate gratification. Embodying all the dire superstition, the idle terrors, the thirst for the strange and wondrous, the story of Faust entertained the popular mind, while the clergy availed themselves of the moral it taught to recall men from sensuality and vice, and from the foolish attempts to fathom the mysteries of the supernatural.

The story of Faust was first published by the printer Spies, of Frankfort-on-the-Main, in 1587, under the title *Historia von D. Johann Fausten, den weitbeschreyten Zauberer und Schwarzkünstler*, and in 1588 another edition was called for. In the latter year appeared also a rhymed edition and a version in Low German and Danish. In 1590 two English translations came out—one entitled *A Ballad of the Life and Death of Dr. Faustus, the great Conjurer*, and the other, *The History of the Damnable Life and Deserved Death of Dr. John Faustus* (which was probably used by MARLOWE (*q. v.*) in 1591 in the preparation of his drama). In 1592 appeared a Dutch and in 1598 a French version. In 1599 G. R. Widmann published an "improved" edition, entitled *Wahrhaftige Historien von den grewlichen und abschewlichen Sünden und Lastern, auch von vielen wunderbarlichen und seltzamem abentheuren so D. Johannes Faustus hat getrieben* (Hamburg, 3 vols.); still further improved by Pfitzer in 1674 (Nuremberg). Widmann's edition, but without his or Pfitzer's notes, was published at Reutlingen in 1834. A large number of books on necromancy have inserted Faust's cabalistic formulas, charms, talismans, etc. All of these publications, and also all important monographs bearing upon this subject, are found in Scheibel, *Das Kloster, weltlich u. geistlich* (Stuttgart, 1847). German literature abounds in elegies, pantomimes, tragedies, and comedies on Faust. As far back as 1594 appeared a work by Tholeth Schotus, purporting to be from the Spanish and treating of Faust and his disciple Wagner. Its form intended it for the marionettes, and it was promptly taken up. (See *Puppenspiel*, edited by Charles Simroek (Leipzig, 1850); Magnin, *Histoire des Marionnettes* (Paris, 1854, 8vo); Hagen, *Ueber die ältesten Darstellungen der Faustsage* (1844); and Scheibel's work.) In a dramatic form, Faust was first treated in the German by Lessing in his masterly fragment entitled *Faust und die Sieben Geister*, but the grandest of all on this subject is Goethe's *Faust*, of which Bayard Taylor furnished a masterly English version (Boston, 1870, 2 vols. 4to). Goethe, however, introduced an element foreign to his model—that of the ardent, inextinguishable thirst for knowledge for its own sake alone. (Compare Kreyssig, *Vorlesungen über Goethe's Faust*, Berlin, 1866, 12mo, p. 3–36.) Goethe's *Faust* has furnished Gounod with the subject of his opera. See Düntzer, *Die Sage von D. Joh. Faust* (Stuttgart, 1846); Peter, *Literatur der Faustsage* (2d ed. Leipzig, 1851); and especially Kühne, *Das älteste Faustbuch* (Leipzig, 1868).

JAMES H. WORMAN.

Faust, originally written **Fust**, JOHANN: a native of Mentz, Germany, who shares with Gutenberg and Schöffer the honor of establishing the art of printing. He was (1450–55) Gutenberg's partner in the new business of printing books, but Faust probably did nothing but furnish capital. In 1455 Faust prosecuted Gutenberg for money advanced, took the business into his own hands, and associated with himself his son-in-law, Peter Schöffer, who originally was a calligrapher of great repute. They carried on the business successfully until 1462, when, at the sack of Mentz, the workmen were scattered and the art of printing was no longer a secret. Faust still went on with his business, and is thought to have died of the plague at Paris in 1466. There are in existence copies of quite a number of books printed by Faust and his partners, some of them beautifully executed.

Faustin I., Emperor of Haiti: See SOULOUQUE, FAUSTIN ÉLIE.

Faustina (THE YOUNGER) **Annia**: daughter of Antoninus Pius; was married by her father to Marcus Aurelius, her cousin, who had been adopted by Antoninus at the suggestion of Hadrian. She died A. D. 175, near Mt. Taurus, in Asia Minor, and though, like her mother, she had proved unworthy of the affection of her virtuous husband, yet at the request of Aurelius divine honors were decreed to her by the senate. As a further testimonial of his regard for her memory, Aurelius established, as Antoninus had done in the case of the elder Faustina, an asylum for orphan girls, to whom the name "Faustinian" (*Faustinianæ*) was given.

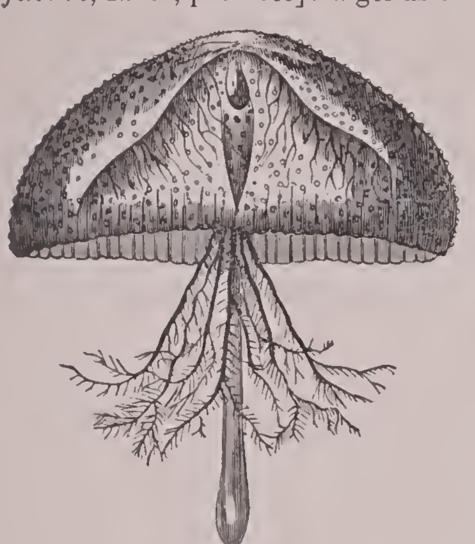
Fauvette [Fr. dimin of *fauve*, fawn-colored]: See Blackcap.

Favara, faa-vaa'raa: town of Sicily; 4 miles S. E. of Girgenti (see map of Italy, ref. 10–E); celebrated for its rich mines of sulphur and its marble quarries. Pop. 17,000.

Fav'ersham, or **Feversham**: municipal borough and river-port of Kent, England; 52 miles E. S. E. of London (see map of England, ref. 12–L). It has valuable oyster-fisheries. Pop. (1891) 10,478.

Favignana, faa-veen-yaa'naa: the chief of the Ægades, a group of islands in the Mediterranean, 6 miles off the west coast of Sicily. It is fruitful, has good pasturage, excellent wine, and a town of the same name with a population of 4,000. Lat. 37° 57′ N., lon. 12° 18′ W.

Favo'nia [from Lat. *Favo'nius*, the west wind, deriv. of *fave're*, favor, promote]: a genus of acalephs (jellyfishes) of the order *Discophora*, including some of the most characteristic organisms of that order. The *Favonia octonema* of the South Seas has a somewhat hemispherical body, with a long proboscis and eight branchiferous appendages.



Favonia octonema.

Favo'nius, Marcus: Roman politician, whose career was marked by strong personal opposition to Pompey and admiration for Cato. In 55 b. c. he was ædile, and probably was prætor in 49; went over to Pompey's party in 48, and after the battle of Pharsalia was reconciled to Cæsar, but after Cæsar's murder was a partisan of Brutus, and was outlawed and put to death 42 b. c.

Favori'nus: a philosopher and rhetorician in Rome under Trajan and Hadrian; b. at Arelate (now Arles) in the south of Gaul. He received his education in Rome, and became distinguished for his knowledge of Greek, in which language he had Dion Chrysostom as instructor. He stood high in the favor of Hadrian, and numbered among his friends Demetrius of Alexandria, Fronto, Plutarch, who dedicated to him one of his treatises, and Herodes Atticus, to whom he bequeathed his library and his house in Rome. Wrote numerous works on a great variety of subjects, all in Greek, and was famed also as an orator. His orations have all perished, but a few fragments of his historical writings have been preserved. See J. L. Marres, *Dissertatio de Favorini Arelatensis vita, studiis, scriptis, accedunt Fragmenta* (Utrecht, 1853). The fragments are collected also in Müller's *Hist. Græc. Fragm.* (vol. iii. pp. 577–585). Revised by B. L. Gildersleeve.

Favosi'tes [Mod. Lat., as if deriv. of *favo'sus*, honeycombed, deriv. of Lat. *favus*, honeycomb; so called because some of the species closely resemble a honeycomb]: a genus of extinct corals exceedingly common in the Devonian and Carboniferous rocks, of which a large number of species are described. The corallum of *Favosites* is compound, and usually forms hemispherical or conical masses, composed of a large number of prismatic columns divided horizontally by transverse septa or *tabulæ*, and usually having the vertical walls pierced by one or several rows of pores.

Favre, faav'r, Jules Claude Gabriel: politician and author; b. in Lyons, France, Mar. 21, 1809; became a prominent lawyer and liberal of Paris, and in 1848 held positions in the revolutionary ministry. He opposed Louis Napoleon during his presidency, and more especially after the *coup d'état* of 1851. In 1858 he ably defended Orsini, the would-be assassin, and in the Corps Législatif eloquently and irreconcilably opposed the policy of the emperor on all leading public questions; opposed the measures which ended in the Franco-German war, and after the fall of Sedan advocated the deposition of the imperial dynasty, and became Minister of Foreign Affairs and vice-president in the provisional government. As Minister of Foreign Affairs he took an important part in the negotiations for peace with Bismarck. He was for a time, during the siege of Paris, acting Minister of the Interior, but withdrew in 1871 from the Government during the presidency of Thiers, and devoted himself to law and literature. He was the author of *Rome et la République Française* (1871) and *Le Gouvernement du 4 Septembre* (1871–72). D. at Versailles, France, Jan. 19, 1880.

Fa'vus [from Lat. *favus*, honeycomb], or **Scald Head** [*scald* for *scalled*, deriv. of *scall*, scurf, scab < M. Eng. *scalle*, from Dan. *skal*, husk. *Scale* and *shale* (< O. Eng. *scealu*) are originally the same]: a disease formerly known as *tinea* and *porrigo*, generally seated on the hairy part of the scalp, but sometimes attacking the roots of the nails and other parts. It is a disease especially met with in the poorer classes, and is somewhat rare in the U. S. It frequently affects cats, rabbits, and mice, from which it may be communicated to man. This disease is known to be caused by a parasitic fungus, known as *Achorion schœnleinii*. Favus is a contagious disease, best prevented by cleanliness, and best cured by carefully removing the hair and applying parasiticide medicines, such as have the power of destroying low organisms. Sulphurous and carbolic acids and weak solutions of corrosive sublimate are the best applications. It is called *favus* because the diseased surface often assumes a honeycombed appearance. It leads to permanent baldness. Revised by William Pepper.

Fawcett, Edgar: novelist and poet; b. in New York city, May 26, 1847; graduated at Columbia College. Among his novels are *A Hopeless Case* (1881) and *The House at High Bridge* (1887). He wrote a successful play, *The False Friend* (1880), and has published a number of volumes of verse, including *Poems of Fantasy and Passion* (1878) and *The Buntling Ball* (1884), a clever anonymous satire which had much vogue. H. A. B.

Fawcett, Henry: political economist and statesman; b. at Salisbury, England, in 1833; educated at Cambridge, where he graduated as seventh wrangler in 1856. In 1858, while hunting near Salisbury, an accidental shot from his father's gun destroyed his eyesight, but this misfortune did not induce him to abandon his determination to enter Parliament, and after three unsuccessful attempts he finally secured a seat in 1865. He had in the meantime brought out his *Manual of Political Economy*, which has passed through many editions. Though this work represents the *laissez-faire* system of economic philosophy, and is based in general on the principles of Ricardo and J. S. Mill, its keen reasoning and clear and effective style have given it a wide popularity. Its publication was followed in the fall of 1863 by his election to the chair of Political Economy in Cambridge, a position which he held till his death. In politics Fawcett was a Liberal, but somewhat inconsiderate of party ties and opposed to several important features of Mr. Gladstone's policy. His career in Parliament was marked by his devotion to the interests of the native populations of India, by his efforts to preserve the commons and open spaces in the towns of Great Britain, and in general by his support of measures of practical reform. After his second election for Hackney in 1880 he was appointed by Mr. Gladstone's government to the Postmaster-Generalship, an office which he administered with zeal and ability, introducing useful reforms into the service and improving the condition of the employees of the department. D. Nov. 6, 1884. The best known of his other writings are *The Economic Position of the British Laborer* (1868); *Pauperism* (1871); *Free Trade and Protection* (1878). Revised by F. M. Colby.

Fawcett, Millicent Garrett: English writer; b. June 11, 1847; married Prof. Henry Fawcett 1867; soon became a prominent leader of the woman's suffrage movement; author of *Political Economy for Beginners*, *Tales in Political Economy*, etc.—Her daughter, Philippa Garrett Fawcett, was born in London, 1868; educated at Clapham High School, Bedford College, and University College, Cambridge, where she passed the higher local examinations with brilliant standing and received the Gilchrist scholarship; attained the unique distinction of being rated as "above the senior wrangler" in the competition in the mathematical group at Cambridge.

Fawkes, Guy, or Guido: English conspirator in the reign of James I.; a Roman Catholic; b. in Yorkshire. From 1593 till 1604 he served in the Spanish army in the Netherlands. In 1605, with Robert Catesby, Thomas Percy, and others, he endeavored to blow up the English House of Parliament, with king, Lords, and Commons, having hired a vault under the House of Lords and lodged in it thirty-six barrels of gunpowder, but was arrested on the night of Nov.

5 in the vault, and hanged at Westminster Jan. 31, 1606. See Jardine, *Narrative of the Gunpowder Plot* and the *Fawkeses of York*.

Fay, Amy: See the Appendix.

Fay, András: poet, dramatic author, and novelist; b. in Kohany, Hungary, May 30, 1786; studied law and became an advocate, but devoted himself chiefly to literary work. He represented the county of Pesth in the Hungarian Diet in 1835, and until Kossuth appeared in political affairs was the most prominent orator of the liberal opposition. He worked earnestly for the literary and artistic, as well as political, advancement of the people; was one of the founders of the Hungarian national theater, the director of important literary and industrial societies, and the founder of the first savings-bank in Pesth. D. in Pesth, July 26, 1864. His *Mesék* (*Fables*) have been translated into German and partly into English, by E. D. Butler, *Hungarian Poems and Fables* (London, 1877). Most of his poems are in the collections *Bokréta* (*Nosegay*), published in Pesth, 1807, and *Fris* (*Fresh*) *Bokréta*, 1818. Of his novels the most interesting are the humorous stories *House of the Beltekis* and *Dr. Javor*. His earlier works were published in eight volumes in Pesth (1843–44); his novels in three volumes (1883).

Fay, Theodore Sedgwick: See the Appendix.

Fayal′: one of the most important of the Azores, a group of islands in the Northern Atlantic belonging to Portugal. It has the best harbor in the islands and lies directly in the track of vessels crossing the Atlantic. Its name is derived from the extreme abundance of the *faya*, an indigenous shrub. It resembles the other members of the group, and has 69 sq. miles, with 24,000 inhabitants. It is very fertile, and besides its considerable transit trade with America it exports a great quantity of oranges and wine. The climate is very healthful. Its principal town, Horta, lies in lat. 38° 30′ N. and lon. 28° 41′ W.

Faye, fā, Hervé Auguste Étienne Albans: astronomer; b. at St.-Benoit, Indre, France, Oct. 5, 1814; studied astronomy with Arago; on Nov. 22, 1843, discovered the comet bearing his name; became Professor of Astronomy in the Polytechnic School at Paris 1873, and published a number of astronomical treatises. The comet which bears his name has a periodic time of seven and a half years, and is never visible to the naked eye.

Fayette: city; on railway; capital of Howard co., Mo. (for location of county, see map of Missouri, ref. 3–G); 12 miles from the Missouri river and 60 miles N. W. of Jefferson City. It is the seat of Central College and of the Howard-Payne College for Women. Pop. (1880) 1,247; (1890) 2,247; (1900) 2,717. Editor of "Howard County Advertiser."

Fayetteville: city and railway center; capital of Washington co., Ark. (for location of county, see map of Arkansas, ref. 2–A); in the Ozark Mountains, 1,500 feet above the sea and surrounded by grand scenery. It is called "the Athens of Arkansas," and is a popular summer resort. It is the seat of the Arkansas Industrial University, and has fine public schools, large wagon-factory, fruit-evaporating establishment, flouring-mills, foundry, etc. Pop. (1880) 1,788; (1890) 2,942; (1900) 4,061.

Editor of "Arkansas Sentinel."

Fayetteville: village; Onondaga co., N. Y. (for location of county, see map of New York, ref. 4–F); on railway; 10 miles E. of Syracuse. It has an excellent union school and academy, a public library, large flouring-mills, paper-mills, a machine-shop, two glove-factories, a furniture-factory, and a large corn-canning factory. The manufacture of hydraulic cement, quick-lime, and land-plaster is extensively carried on. Pop. (1880) 1,556; (1890) 1,410; (1900) 1,304.

Editor of "Recorder."

Fayetteville: town and railway junction; capital of Cumberland co., N. C. (for location of county, see map of North Carolina, ref. 4–G); on the Cape Fear river; 60 miles S. by W. of Raleigh and 90 miles N. W. of Wilmington. It has a flourishing graded school, a dozen or more private and primary schools, a State normal colored school, an excellent school for colored children, a fine military school, a carriage-factory, a wagon-manufactory, a large corn and wheat roller-mill, an ice-factory, 4 mills, 2 coppersmith establishments, an extensive manufactory of wooden-ware, a large vineyard, gas and electric lights, and water-works. There are also several cotton-factories near the village. It has a large trade in rosin, turpentine, and cotton, is a great horse and mule market, and has several steamboats running to Wilmington. Fayetteville is an old town and was for many years the State capital. It suffered largely from invasion and destruction to property at the close of the civil war; prior to this it was commercially and in other respects the most important city of the State. Pop. (1880) 3,485; (1890) 4,222; (1900) 4,670. Editor of "Observer."

Fayetteville: town (founded in 1808); capital of Lincoln co., Tenn. (for location of county, see map of Tennessee, ref. 7–F); on railway; 120 miles by rail S. by E. of Nashville. It has 10 churches (6 white and 4 colored), 2 flourishing schools, a large flouring-mill, 2 planing-mills, electric lights, etc. Pop. (1880) 2,104; (1890) 2,410; (1900) 2,708.

Editor of "Observer."

Fayrer, Sir Joseph, K. S. C. I., LL. D., M. D., F. R. S. E.: b. at Plymouth, Dec. 6, 1824; studied medicine in London, Edinburgh, and on the Continent; entered the Bengal medical service in 1850; served in the Burmese war of 1852 and during the mutiny of 1857, and was appointed Professor of Surgery in the medical college of Bengal in 1859, and in 1874 surgeon-general and president of the medical board of the India office. Among his published papers are *Clinical Surgery in India*; *Clinical and Pathological Observations in India*; *European Child-life in Bengal*; *Malarial Splenic Cachexia of Tropical Climates*; *Bronchocele in India*; *Physiological Action of the Poison of Naja Tripudians*; *Some of the Physical Conditions of the Country that Affect Life in India*; *The Claws of the Felidæ*; *Anatomy of the Rattlesnake*.

Fayum, Fayoum, or **Faioum** [from the Coptic *pi omi*, the cultivated land, or (according to some) from *pi eiom*, the sea]: a province of Egypt; on the west side of the Nile, between lat. 29° and 30° N. and lon. 30° and 31° E. Area, 493 sq. miles; pop. in 1897, 312,757. Its capital, Medinet-el-Fayum (pop. 31,262), is about 65 miles S. W. of Cairo and 30 miles N. W. of Benisuef. The Fayum is a basin formed by a depression in the Libyan range, its main plateau being on about the level of the Nile, but in its lowest point 116 feet below sea-level. Of its area, which was anciently somewhat greater than at present, more than 100 sq. miles are occupied by the natural lake Birket-el-Kerun. It is still the most fertile province of Egypt, abounding in figs, grapes, apricots, olives, and other fruits. But its ancient renown was much greater. It contained the Labyrinth and the artificial lake Mœris (*qq. v.*), both built by Amenemka III., the great king of the twelfth dynasty—according to Wilkinson, nearly 2000 B. C.; according to Mariette, nearly 3000 B. C. See Herodotus, ii. 148–150; Auguste Mariette Bey, *Aperçu de l'Histoire d'Égypte* (2d ed. 1870); and Zincke's *Egypt of the Pharaohs and of the Khedive* (1871).

Fazy, faa'zee', Jean James: Swiss party leader; b. in Geneva, May 12, 1796; descended from a family of French Protestants exiled by the Revocation of the Edict of Nantes. He was educated in France, studied law and political economy, and settled in Paris, where he took active part in the opposition of the liberal party to the restoration. Returning to Geneva, he joined the radical party, which in 1846 succeeded in changing the constitution. Fazy was the head of the government 1846–63. After the fall, however, of the French republic, in 1852, the position of the radical party in Geneva became less and less secure. It lost its hold on the sympathy of the masses; it suffered one defeat after the other; a heavy reaction at last set in and became almost threatening; and in 1865 Fazy retired into private life. D. in Geneva, Nov. 6, 1878.

Fear, Cape: See Cape Fear.

Feast, or **Festival** [*feast* is from M. Eng. *feeste*, *feste*, from O. Fr. *feste* > Fr. *fête* < Lat. *fes'ta*, plur. of *fes'tum*, a holiday, neut. of *fes'tus*, festal; *festival* is from M. Eng. *festival*, from O. Fr. *festival* < Mediæv. Lat. *festiva'lis*, deriv. of Lat. *festi'vus*, festive]: a periodically returning or occasional day set apart for rejoicing, and often distinguished by the observance of religious ceremonies. There has probably never been any community which has not had its festivals, and which has not owed much to them. Such aids were formerly more important, for higher civilization multiplies bonds of union. As their history shows, a marked influence on the segregated states of Greece was produced by their common festivals, the Olympic, Pythian, Isthmian, and Nemean games. To these all of Hellenic race were admitted, and none other, as competitors for the prizes given. The right to contend was highly esteemed. Each state habitually sent representatives, and so did colonies when scarcely any other tie was maintained with the mother country. It could not be that the associating thus as members of one family on equal footing did not keep alive to some extent a feeling of common interest. Whatever their dissensions among themselves, as against the rest of the world they were of one blood; they made a clear distinction between Greeks and barbarians, and their national games helped to mark this line of separation and to draw them to each other. Among the Romans there were many festivals, private and public; the latter were *stativæ*, fixed, or *conceptivæ*, movable, or *imperitivæ*, occasional; these were divided into days of sacrifice and days of banqueting, days of games and days of rest, or *feriæ*. Some of the feasts were celebrated with very great pomp.

It has been said that the observance of seasons is in obedience to an instinct with most persons. The believer in revelation recognizes also that it was commanded by God. The Son of Sirach asks (Eccles. xxxiii.), "Why doth one day excel another, whereas all the light of every day in the year is of the sun? By the knowledge of the Lord they were distinguished; and he altered the seasons and the feasts. Some of them hath he made high days and hallowed, and some of them hath he made ordinary days." In Leviticus xxiii. is given a list of the "feasts of the Lord"; α. The Sabbath; β. The Passover; γ. The Feast of Weeks; δ. The Feast of Trumpets; ε. The Atonement; ζ. The Feast of Tabernacles.

Under the New Testament there are no festivals of Divine appointment, save as the Church rules in God's name—none enforced as were those commanded to Moses. During the first few years of Christianity while the essentially Jewish character of the Church was in a measure continued, the Jewish yearly festivals were without doubt observed, especially the Passover and Pentecost, which associations with the Resurrection and the gift of the Holy Ghost had invested with an increased dignity. The Jewish Sabbath, the seventh day of the week, also continued to be observed, and with it the first day of each week became a lesser Easter day—"an Easter day in every week." Additions were gradually made to these feasts, until each prominent event in the life of our blessed Lord had its special day of observance. Some of these are, as near as may be, anniversaries; others are assumed to be such. Some are fixed, recurring always on the same day of the month; others, dependent upon Easter, are movable. All Christian bodies who keep stated festivals agree in their general observances while differing in respect to the minor feasts. The Church of England, when the Book of Common Prayer was set forth, provided special services (with two exceptions) only for the days of saints connected directly with the history of our Lord, while yet, from whatever reason, other names were retained on her calendar. The Episcopal Church in the U. S. has omitted all days for which there is no prescribed service.

As the term "holy day," a day of sacred rest, has been changed to "holiday," a mere season of leisure and enjoyment, so the word "feast" has naturally come to express in a lower sense feasting, banqueting. For, as sorrow is marked by a setting aside of luxuries, so joy that is shared with others generally finds expression in indulgence of appetite, in eating and drinking. The plea, "for good fellowship," which has led to so much intemperance, has its warrant in nature, if the habits of all ages result from the teaching of nature. The word *festum*, whence comes "feast," has been derived from ἑστιάω, to "receive on one's own hearth," to "feast"; however true this may be, festivals were always accompanied by sacrificial banquetings. The habits of the Jews on glad days holy to the Lord was to "eat the fat, drink the sweet, and send portions." And in the Christian Church, while spiritual joy is not connected with indulgence of the senses, feasts are contrasted with fasts. The most ascetic rule is modified by the occurrence of a feast-day. Revised by S. M. JACKSON.

Featherfoil [*feather* + *foil* < M. Eng. *foile*, from O. Fr. *foil*, *foille* > Fr. *feuille* < Lat. *fo'lium*, leaf], **Water-feather**, or **Water-violet**: the popular name of the *Hottonia inflata* of the U. S. and *Hottonia palustris* of Europe, curious primulaceous plants which grow submerged in water, and thrust up long scapes into the air to produce the blossoms, which in the European species are very beautiful. Other species are known. The generic name commemorates Peter Hotton, a Dutch botanist who died in 1709.

Feather-grass [so called from its long feathery awns]: any one of several long-awned grasses, particularly any species of the genus *Stipa*, several of which grow in the U. S. From the hygroscopic twisting and untwisting of these awns the name "weather-grass" is also used. This hygroscopic twist causes the awn to screw the seed down into soft earth, where it takes root. On the Great Plains of the Western U. S. some species, e. g. *S. spartea* and *S. comata*, are called porcupine grasses because the pungently pointed fruits work their way into clothing, and even through the skin. Sheep and dogs are often seriously injured by them.

CHARLES E. BESSEY.

Feather River: a river of California; formed by the union of its N., S., and Middle forks, which rise in Plumas County, in the Sierra Nevada. Its waters reach the Sacramento in Sutter County. It is a beautiful stream, whose lower waters are navigated by steamboats as far as Yuba City.

Feathers [M. Eng. *fether* < O. Eng. *feðer*, feather, pen: Icel. *fjöðr* : O. H. Germ. *fedara* < Mod. Germ. *Feder*, feather, pen < Teuton. *feþr-a* < Indo-Eur. *pet-*, fall, fly, cf. Sanskr. *pattra*, feather, Gr. πτερόν, feather, and Lat. *pen'na* (for **pet-na*), feather]: epidermal structures peculiar to birds. No bird is without feathers, and no other animal has them. A typical feather consists of a stiff central stem, or *scapus*, on either side of which is the soft web, or *vexillum*. The stem consists of the lower, horny, transparent barrel, quill, or *calamus*, and the shaft (*rhachis*). The shaft, which is usually longer than the quill, tapers from base to apex, is nearly four-sided, and is more or less curved toward the bird's body. Its inner face is marked with a fine longitudinal groove, while the outer surface is smooth and slightly convex. It is composed of a white elastic pith, covered by a horny material similar to that of the barrel. At the point where quill and shaft unite there frequently grows from the barrel an appendage termed the aftershaft, or *hyporhachis*. This is usually small and downy, but in the emu and cassowary it almost equals in size the feather from which it springs. The web is formed by the long slender *barbs* which grow from either side of the shaft, and in a like manner short *barbules* spring from the sides of the barbs, each barb being thus a feather in miniature. The upper and under edges of the barbules give off little hair-like projections, or *cilia*, and finally these may terminate in little hooks, *hamuli*. The object of these little hooks, which grow only on the under side of those barbules which point toward the tip of the feather, is to fasten the barbs together, and make the web a compact structure. This they do by catching on the upper edges of those barbules pointing toward the root of the feather. These upper edges bear no hooks, but are simply bent over.

Feathers may be divided into several classes, although no hard and fast line can be drawn among them, and between the firmest feather and the softest down all intermediate conditions may be found. The first and largest group is that of contour feathers, *pennæ* or *plumæ*. These have a well-developed shaft and webs, and attain their greatest development as tail or wing feathers. Some contour feathers have the barbs far apart and the barbules without hooks, and such are soft and wavy in their character, like the plumes of birds of paradise. Others again may lack the web, like some of the tail feathers of birds of paradise and of the lyre bird, and the bristles about the mouths of goat-suckers.

The downs, *plumulæ*, which are usually hidden beneath the contour feathers, have the *rhachis* weak or wanting, the barbs long, soft, and loose, owing to the absence of hooks. Lastly the filoplumes, *filoplumæ*, are slender, hair-like feathers, such as are seen here and there projecting from among the neck feathers of sparrows or thrushes. The down which clothes the young of birds is slightly different from that on the adults, as the barbules have no projections whatever, and the barrel has no aftershaft.

The first indications of feathers are minute projections which appear on the skin of the embryo about the fifth or sixth day, and from these the downy covering is developed. The feathers which follow are produced from the same pulp, the feathers being formed around the papilla, between it and the inclosing sac or sheath. Prof. Huxley in his *Introduction to the Classification of Animals* describes the process as follows: "The external surface of the dermal papilla, whence a feather is to be developed, is provided upon its dorsal surface with a median groove, which becomes shallower toward the apex of the papilla. From this median groove lateral furrows proceed at an open angle, and passing round upon the under surface of the papilla become shallower, until, in the middle line, opposite the dorsal median groove, they become obsolete. Minor grooves run at right angles to the median furrows. Hence the surface of the papilla has the character of a kind of mold, and if it were repeatedly dipped in such a substance as a solution of gelatin, and withdrawn to cool until its whole surface was covered with an even coat of that substance, it is clear that the gelatinous coat would be thickest at the basal or interior end of the median groove, at the median ends of the lateral furrows, and at those ends of the minor grooves which open into them, while it would be very thin at the apices of the median and lateral grooves, and between the ends of the minor grooves. If, therefore, the hollow cone of gelatin, removed from its mold, were stretched from within, or if its thinnest parts became weak by drying, it would tend to give way, along the inferior median line, opposite the rod-like cast of the median groove and between the ends of the casts of the lateral furrows, as well as between each of the minor grooves, and the hollow cone would expand into a flat feather-like structure with a median shaft and a 'vane' formed of 'barbs' and 'barbules.' In point of fact, in the development of a feather, such a cast of the dermal papilla is formed, though not in gelatin, but in the horny epidermic layer developed upon the mold, and, as this is thrust outward, it opens out in the manner just described. After a certain period of growth the papilla of the feather ceases to be grooved, and a continuous horny cylinder is formed, which constitutes the quill."

The growth of feathers is very rapid, and if by mischance a feather is lost or injured another is formed in its place. The only feathers which grow continuously are the greasy powder-down feathers such as are found on herons.

The first feathers of a bird are direct continuations of the down with which the nestling is clothed, this down being borne on the tips of the growing feathers and later on broken or worn off. The second, and all succeeding growths of feathers, although produced from the same papillæ as the first, have no connection with their predecessors, the old feathers being shed and new ones grown in their places.

This change of plumage, termed molting, takes place at least once annually, while some birds molt wholly, or partially, twice a year. Some birds, like the crow, acquire their adult plumage at the first molt; others, such as the albatross and male eider duck, require several years for the attainment of their full dress.

When, as is often the case, the sexes are different in color, the young birds of both sexes resemble the female, and it is also common for the fall dress of the male to be like that of his mate, the more brilliant and distinctive plumage being assumed for the nuptial suit of spring.

The colors of feathers are due to the presence of pigment in the feathers, to pigment combined with a peculiar arrangement of their outer surface, or to the structure of the outer surface alone. To the first class of colors belong black, red, and brown; the second are well shown by the green or blue feathers of parrots, while the gorgeous metallic hues of humming-birds are examples of the third. White is not due to pigment, but to the presence of innumerable air-cells in the substance of the feather.

The entire plumage of a bird forms its *ptilosis*, the manner in which the plumage is arranged its *pterylosis*, and this is treated of under PTERYLOGRAPHY (*q. v.*).

The chief use of feathers is probably for ornament, and, aside from ostrich plumes, the number of birds used for millinery purposes is enormous. The quarterly sales of a single London firm have amounted to 750,000 skins of bright-plumaged birds, while the dainty humming-birds are received in lots of from 10,000 to 40,000 at a time. The Aztec nobles robed themselves in feather garments, the Chinese wove feathers into cloth, and the mamo (*Drepanis pacifica*) was exterminated that its feathers might be woven into the cloaks of the Sandwich Island chieftains. The days of the ostrich have been lengthened by the fact that it has proved practicable and, what is more to the purpose, profitable to domesticate the bird, so that a large share of the ostrich feathers of commerce are supplied by the ostrich farms of the Cape of Good Hope, California, and other localities. The wing and tail feathers of the male are the most valuable, but all, even the smallest, are utilized.

The ostrich of South America serves a strictly utilitarian end in supplying the feathers for dusters, and the common turkey contributes largely to the same purpose.

The Australian emu furnishes feather trimming, and the silky breast of the grebe is converted into muffs and collars.

The Romans used feathers for stuffing beds and cushions. "The geese that come from Germany," says Pliny, "are most esteemed. They are white, of a small size, and are called *gantæ*. The price paid for their feathers is ten denarii per pound. Hence we have repeated charges brought against the commanders of our auxiliaries, who detach whole cohorts from their posts in pursuit of these birds." Pliny further complains: "We have reached such a pitch of effeminacy that nowadays not even men can lie down without the aid of goose feathers as pillows." (*Nat. Hist.*, x. 27.) Down was also used. Martial, in his 161st epigram, says, "When fatigued, you may recline on Amyclæan feathers, which the swan's inner down provides for you."

The date when feather beds were first used in England is unknown. An old chronicle states that the Duke of Gloucester, uncle to Richard II., was smothered with "a federbedde." (Strutt, *Manners and Customs of the English*, ii. 88.) By a statute of Henry VII. it was forbidden to make beds of mixed down and feathers: "The mixture of such being conceived contagious for man's body to lie on." (*Stat.* xi., ch. 59.) From this period "fether-beddes" are included in most inventories of household furniture.

Goose feathers are exported from Germany, Russia, and Poland, the annual consumption of the United Kingdom alone being something like 700 tons. In the fenny parts of Lincolnshire, called Holland, flocks of geese are kept for the sake of their feathers, which are plucked four or five times a year. New feathers are dried by the sun's heat or in ovens, and then beaten to clean them. Those that have been used are purified by a short exposure to steam, and are dried in the air. Eider down, so much prized for lining quilts, skirts, etc., is found most commonly on small rocky islands from 45° N. to the highest Arctic regions yet explored.

The oldest authentic mention of writing-quills is in a passage of Isidorus, who died in 636. (*Origines*, lib. vi. 13, p. 132, cited in Beckmann's *History of Inventions.*) A short poem on a writing-pen is found in the works of Aldhelmus, who died in 709. The Dutch invented the art of preparing quills so as to free them from a fatty humor which prevented the ink from flowing. They used hot ashes, and for a long time kept the process a secret, but it was discovered and improved. A bath of fine sand is kept at a temperature of 140°; into this the quill end of the feather is put and left a few instants. It is then rubbed with flannel, and becomes white and clear. The yellow tint of age is given by dipping the quills into diluted muriatic acid and then drying them. Each goose-wing produces five good quills, which are classified according to their order in the wing, the first being the best. A portion of the barb is stripped off for packing. A pen-cutter will make about 800 pens in a day. So late as 1855 Great Britain imported no less than 26,500,000 goose and swan quills. F. A. LUCAS.

Feather-star: the popular name in England for crinoids belonging to the genus *Comatula* or *Antedon*. In the young stages they are fixed, like other crinoids, on a stem, but when adult the disk and arms become detached and live a free life. Both mouth and vent are on that side of the disk opposite to the stalk, while from the disk radiate five feathery arms, whence the name. J. S. K.

Featherstonhaugh, GEORGE WILLIAM, F. R. S.: traveler and author; b. in 1780; published a translation of the *Republic* of Cicero in 1828; in 1834 made a *Geological Report of the Elevated Country between the Missouri and Red Rivers*; *Geological Reconnoissance in 1835 to Coteau de Prairie* (1836); *Excursion through the Slave States* (1844); *Geology of Green Bay and Wisconsin* (1836); *Observations on the Ashburton Treaty* (1842); and *Canoe Voyage to the Minnesota* (2 vols., 1847). He was commissioner for Great Britain to settle the northern boundary of the U. S. under the Ashburton treaty; afterward British consul for Calvados and Seine, France. D. at Havre, France, Sept. 28, 1866.

Febiger, JOHN CARSON: See the Appendix.

Febric'ula, or **Ephemeral Fever** [*febricula* is Lat. dimin. of *febris*, fever (see FEVER); *ephemeral* is viâ Mod. Lat. from Gr. ἐφήμερος, lasting for a day; ἐπί, upon + ἡμέρα, day]: a short feverish attack lasting from one day to a week, marked by a rapid pulse, a furred tongue, and often by a very considerable increase of heat and by headache. Persons suffering from febricula are said to be "threatened with a fever," and are too often improperly dosed. A warm bath, warm or cold water to drink, as best suits the patient, the use of enemata if called for, and other simple treatment is sufficient, for the disease will pass away of itself if allowed to do so. It is often followed by an eruption or a stage of profuse sweating. There would appear to be no constant factor in the causes of febricula, which may be associated with a severe cold, a profound emotional disturbance, or with some excess on the patient's part. It is especially common during epidemics of typhoid and typhus fevers.

Feb′rifuge [from Fr. *fébrifuge* : Ital. *febbrifugo* < Low Lat. **febri′fugus* ; *fe′bris*, fever + *fuga′re*, drive away, deriv. of *fu′ga*, flight]: a medicine capable of diminishing or banishing fever. The term was formerly used in the sense of a remedy which has the power of entirely removing fever. In the present state of knowledge it is clear that remedies hardly ever have this power, for on the one hand the infectious diseases known as "fevers" are for the most part self-limited diseases which subside when the infection has spent its force, and in which the temperature or fever may only be temporarily reduced, and on the other hand the fevers due to inflammations are permanently removable only by removing the cause. In the limited sense of temporarily reducing temperature there are a number of remedies which may be styled febrifuge. Aconite, sweet spirits of niter, and quinine are the drugs most frequently used in mild cases; and antipyrin, antifebrin, and phenacetin those which are useful in severer fevers; but the external use of cold water has to a large extent supplanted these remedies. In typhoid fever, particularly, cold bathing is of great value, and under its use the mortality in this disease has been lowered fully 10 per cent., that is, from a previous death-rate of 15 per cent. to 20 per cent. the mortality is now reduced to 5 per cent., and under the most favorable circumstances only 1 per cent. of patients succumb. There is often objection on the part of the patient's friends against a seemingly cruel treatment, for the patient often shivers and moans or grows somewhat blue, but the systematic employment of this mode of treatment in hospitals has been overwhelmingly convincing of its value. Sponge bathing, with water or diluted alcohol, or the cold pack (wrapping the patient in sheets wrung out in cold water), may be used instead of the full bath, but are much less powerful.

Revised by WILLIAM PEPPER.

Febro′nianism [deriv. of *Febronian*, pertaining to Justinus Febronius, the pseudonym of the founder of Febronianism]: the views taught in the writings of J. N. von Hontheim (1701–90), suffragan bishop of the Roman Catholic diocese of Treves. He taught that the primacy of the pope is of human origin, and opposed with great success the Ultramontane view. He had many followers, but in his old age was so annoyed by the persecutions visited upon himself and his family that he recanted twice, and finally abandoned his bishopric; but Febronianism long survived, and the Old Catholic movement of the nineteenth century is its development. See HONTHEIM, VON.

February [from Lat. *Februa′rius*, deriv. of *fe′brua* (plur.), the festival of purifications, deriv. of *februa′re*, purify, akin to *febris*, fever]: the second month of the Gregorian year, having twenty-eight days, except in leap-years, when it has twenty-nine.

Fécamp, fā′kaán′ (in Lat. *Fiscannum*): seaport of France, department of Seine-Inférieure (see map of France, ref. 2–E). Its port, though small, is one of the best on the English Channel, and is much frequented by colliers from Newcastle and Sunderland, and by timber-ships and fishing-vessels from the Baltic. Lat. of Fécamp light, 49° 46′ N., lon. 22′ E. It is a favorite resort for sea-bathing, and has ship-yards, tanneries, cotton-mills, sugar-refineries, and some manufacturing interests. Pop. (1896) 14,656.

Fechner, fech′ner, GUSTAV THEODOR: scientist; b. at Gross-Särchen, Germany, Apr. 19, 1801; after a brilliant course of study at Sorau and Dresden studied medicine at Leipzig, where he was Professor of Physics from 1834 till 1839; wrote much and ably upon chemistry, physics, anthropology, medical science, philosophy, and antiquities, and under the pen-name of Dr. Mises, poetry, criticism, and humorous literature. Among his more important works are *Ueber das höchste Gut* (1848); *Elemente der Psycophysik* (1860); *Zur Geschichte der Holbeinschen Madonna* (1866). D. Nov. 18, 1887.

Fechter, fech′ter, CHARLES ALBERT: actor; b. in London, Oct. 23, 1824. His father was a German, his mother a Frenchwoman, and he was educated in England and France. For some time he devoted himself to sculpture, but having an inclination for the stage, he made his *début* in 1840 at the Salle Molière in *Le Mari de la Veuve*; after passing some weeks at the Conservatory he joined a company and made the tour of Italy; on his return he resumed his occupation of sculptor. His first success on the French stage was as Duval in *La Dame aux Camélias*. In 1860 he appeared on the stage as Hamlet, and in 1861 as Othello; and in 1863 he leased the London Lyceum theater and produced *The Duke's Motto*, *Bel Demonio*, etc., assuming the principal characters himself. In 1870 and in 1872 he played successful engagements in the principal cities of the U. S., and managed the Globe theater in Boston for a season. He purchased a farm near Quakertown, Pa., and died there Aug. 5, 1879.

Feckenham, or **Feckenam**, JOHN, de: Catholic divine, whose real name was HOWMAN: b. in Feckenham Forest, Worcestershire, England, about 1516; educated at the Benedictine monastery at Evesham and at Gloucester College, Oxford, where he took the degree of B. D. in 1539. Chaplain to the Bishop of Worcester and afterward to Bonner, Bishop of London, both vigorous opponents of the reform movement, he showed such zeal for his religion that he was sent to the Tower 1549, but afterward released temporarily to take part in religious disputations. On Mary's accession he was received into favor, and in 1556 made Abbot of Westminster. During Lady Jane Grey's captivity he was sent to convert her to the Roman Catholic faith, but did not succeed. In his time of prosperity he showed a tolerant spirit toward the Protestants, opposing the adoption of cruel measures against them, and going so far as to intercede with the queen for the imprisoned Elizabeth, a service which the latter rewarded after her accession by the offer of the archbishopric of Canterbury, subject, however, to the condition of conforming to the newly established religion. Feckenham refused, and in Parliament, where he was the last of the mitered abbots to have a seat, he opposed every measure in the interest of the reformed Church. He was again thrown into the Tower 1560, and for the rest of his life was held in confinement, with the exception of a few brief intervals. D. at the Castle of Wisbeach, 1585. He has left, besides funeral orations and sermons, an account of his interviews with Lady Jane Grey in the *Conference Dialogue*.

Fec′ula: See STARCH.

Fecundation: See EMBRYOLOGY and GESTATION.

Federalist [deriv. of *federal*, from Fr. *fédéral* < Lat. **fœdera′lis*, deriv. of *fœ′dus*, *fœ′deris*, league]: a term in politics which in general is applied to an advocate and supporter of a close union of states under a common government as against those who would weaken or destroy such a union. More specifically the term has been applied to a remarkable series of papers written in the early history of the U. S. Government for the purpose of securing the adoption of the Federal Constitution, and to the political party which, immediately after the adoption of the Constitution, advocated a strong central government instead of a weak one.

I. With the exception of the concluding nine of the eighty-six numbers, the collection of essays termed the *Federalist* was originally published in *The Independent Journal*, a semi-weekly newspaper printed in the city of New York, between Oct. 27, 1787, and Apr. 2, 1788. Its authors were Alexander Hamilton, James Madison, and John Jay, who addressed themselves over the common signature of "Publius," in a series of letters, "To the People of the State of New York," with the avowed purpose of securing the accession of that State to the Constitution as proposed by the Federal convention of Sept. 17, 1787.

The immediate cause, or, so to say, provocation of the work, was the appearance, almost simultaneously with the recommendation of the convention, of two series of able articles so severely criticising the proposed Constitution that its adoption was more than endangered. Hamilton resolved to counteract these attacks through the same means, the public press—to answer the arguments advanced, and, in reply to a charge that the supporters of the Constitution designed to supplant the Union of the States by their fusion under a centralized (if not monarchical) government, to retort upon its opponents with an implied accusation of favoring the division of the States into separate confederacies. For this purpose he drew up a syllabus of essays, to be written by himself and associates, which should perspicuously exhibit the advantages of the Union, expose the insufficiency of the subsisting Confederation, with the necessity of a more energetic government, and advocate the plan under consideration by showing that it was the least objectionable of all feasible schemes, and that it conformed to republican principles and approved institutions.

It is beyond reasonable doubt that Jay, then Secretary for Foreign Affairs, discussed the foreign relations of the States in the second, third, fourth, and fifth numbers, and the lodgment with the Senate of the treaty-making power in the sixty-fourth. Concerning the respective shares of Hamilton and Madison in the authorship a dispute early arose between the admirers of those gentlemen. The curious reader may consult the introduction to Mr. Dawson's edition for a summary account of this not unembittered controversy, which was never of much moment save, perhaps, as to No. 49 and those immediately succeeding, relating to the independence of the several departments of the government. It is a noteworthy indication of the importance attached by Hamilton to the posthumous fame of his connection with the work that he was at pains to leave a significant memorandum concerning it in the office of a friend the day before his fatal duel with Aaron Burr.

In estimating its merits the *Federalist* is to be judged as a collection of fugitive pieces intended to vindicate a specific Constitution, rather than as an elaborate treatise on the science of government. For the end aimed at it was admirably adapted. The basis of the argument well-nigh throughout is utility, or, as has been somewhat harshly said, "interest and fear." From this point of view it would have been difficult to adduce more convincing reasons for the preservation of the Union; many of them, in the light of more recent events, savor of prescience. The method is mainly empirical, rarely speculative. The style is elevated, yet designedly popular. The whole is replete with more or less familiar illustrations, particularly from history. It may be true, as was the opinion of John Stuart Mill, that a more philosophical work upon modern democracy has been founded upon American institutions, but it was also said by a no less eminent foreigner, M. Guizot, that "in the application of the elementary principles of government it is the greatest work known."

If the Constitution is to be interpreted according to the intention of its framers and the understanding of those who ratified it, an acquaintance with the *Federalist* is nearly indispensable. It also affords a valuable view of many of the cardinal differences of the parties which, under various names, have contended in American politics.

The first collected edition appeared in 1788 in two 12mo volumes from the press of J. & A. M'Lean, the proprietors of *The Independent Journal*. It has since been issued, in the U. S. and abroad, in over twenty editions. The references in this article, however, are made to the numbers of the first and more familiar edition.

II. Whatever the proximate cause, the real basis of the *Federalist* party must be sought in divergent connections and interests of long and gradual growth. Upon the accomplishment of the Revolution and relaxation of the motives to the self-denial which alone had made it possible, the necessity of a more vigorous authority for the unimpassioned purposes of peace became manifest. What change would be most expedient was the question to be decided.

Experience of the shortcomings of the existing system had peculiarly impressed its defects upon the leading citizens who had had the most to do with administering it. A majority of these were imbued with British constitutional traditions and not unaffected by the exercise of peremptory powers during the war. They distrusted the capacity of the masses to manage their own concerns, and feared in the common people a disrespect for the rights of persons and of property. They believed it necessary to consolidate the country under a general national government powerful enough to dominate the whole. Though by no means harmonious as to the powers to be conferred, they were unanimously in favor of a "strong government." With these the commercial classes generally sided, as did also the greater number of those distinguished by wealth and social position.

On the other hand, the very self-sacrifice so long practiced had increased the attachment of the masses for independent local institutions, and quickened their jealousy of an overshadowing authority beyond the reach of "a swift responsibility." They had dearly learned the worth of the Union, but, imputing to the more aristocratic party a design to subvert their liberties, and believing a limited alliance of free States sufficient for their purposes, they desired to retain the federal league (under the Articles of Confederation), somewhat modified to suit unforeseen needs.

Out of this conflict came the Constitution, "extorted," in the words of John Quincy Adams, "from the grinding necessity of a reluctant nation." By one of those freaks of nomenclature not uncommon in religion and politics, those who favored the consolidation of the States into one nation received the name of "Federalists," while the misnomer of "Anti-Federalists" was bestowed upon their opponents, who least of all deserved it.

With the administration of Gen. Washington the Federalists came into ascendency. In common with the Anti-Federalists, having only accepted the compromise Constitution in default of something more to their liking, they, under the accomplished leadership of Hamilton, set about finding in that instrument a warrant for the government they desired through the doctrines of "implied and constructive" constitutional power, of the exercise of which the establishment of a national bank and the assumption of the State debts may serve as examples. This caused the defeat of the Federalists and the accession of their opponents (under the name of Republicans) in the election of Thomas Jefferson, who announced as the new policy "the support of the State governments in all their rights as the most competent administrations for our domestic concerns and the surest bulwark against anti-republican tendencies—the preservation of the general government in its whole constitutional vigor as the sheet-anchor of our peace at home and safety abroad." The power of the Federalists was irretrievably lost by their action in the famous HARTFORD CONVENTION (*q. v.*), which was called to protest against alleged neglect of New England during the last war with Great Britain, but which fastened upon them the imputation of condemning the war itself. The party, as such, expired six years later on the election of Mr. Monroe and the commencement of the "era of good feeling."

III. The term *Federalist* has also been used at other periods to designate other less prominent partisans, particularly in Spain and Spanish America.

Revised by C. K. ADAMS.

Federalist Party: See FEDERALIST and REPUBLICAN PARTY.

Federal Theology: See COVENANT.

Federation [from Fr. *fédération* < Lat. **fœdera'tio*, deriv. of *fœdera're*, federate, deriv. of *fœdus*, league]: a union of states under a compact by which the general or common government is supreme in its own sphere. As distinguished from a confederation, with which it is often confounded, a federation is a composite sovereignty under a supreme government formed from attributes of sovereignty relinquished by the constituent states or component parts of the new body politic. It follows, as to domestic economy, that a federal government within its proper sphere can act directly upon the individual citizens of the several states, instead of mediately through the state governments; as to international relations, it follows, further, that the supreme central power alone can hold intercourse with foreign governments, which recognize only independent sovereignties. Contrariwise, the several states forming a confederation retain their autonomy and sovereignty, and can maintain all international relations not conflicting with the conditions of the union, while the individual subject is answerable only to his own state government. In short, a confederation differs little from an ordinary alliance except in the permanency and intimacy of the association. The distinction between the two forms of government is aptly suggested by the German names *Bundesstaat* (Union-State) and *Staatenbund* (Union of States), as also in the phraseology of English writers on constitutional law by the terms "composite state" and "system of confederated states."

The principal existing examples of this form of government are the American republics and the federation of the Swiss cantons. In all of these the superintendence of the foreign relations of the states is vested in general congresses, which also have more or less direct and controlling relations to the individual subjects. The U. S. of America furnish the most complete and thorough model of a federation (see CONSTITUTION OF THE UNITED STATES)—a model after which the other American federations have been more or less directly fashioned. The latter are the United States of Mexico (twenty-seven states, a federal district, and a territory), the United States of Colombia (Antioquia, Bolivar, Boyacá, Cauca, Cundinamarca, Magdalena, Panama, Santander, Tolima), and the United States of Rio de la Plata (fourteen provinces, commonly called the Argentine Republic).

The Swiss or Helvetian federation is composed of twenty-two political cantons, of which the supreme authority is vested in a federal diet composed of a national council (a deputy for every 20,000 inhabitants) and a state council (two delegates from each canton). Seven members are chosen by the two branches of the diet, on a joint ballot, to form the federal council, which exercises the executive authority under a president, who holds office but one year, and is ineligible for the next ensuing term. The diet is responsible for the internal and external security of the federation. It alone can declare war or conclude treaties of peace, commerce, or alliance with foreign powers. The several cantons can, however, conclude conventions respecting matters of revenue and police with subordinate departments of foreign governments, subject to the approval of the federal authority. Revised by C. K. ADAMS.

Federmann, fā'der-maăn, NICHOLAS: soldier; b. at Ulm, in Swabia, Germany, 1501. In 1529 he went to Venezuela as a captain in the employ of the Welsers of Augsburg; there he was made chief lieutenant of Alfinger, and conducted an extended exploration from Coro to the interior. After visiting Europe (1532) he returned in 1534 as lieutenant of George of Spire. The latter started for the interior, leaving orders for Federmann to follow with re-enforcements; instead of doing so, he engaged in pearl-fishing on the coast, and in 1535 started on an independent expedition with 200 men. He wandered for some years in the Orinoco valley, finally crossed the mountains westward, and early in 1539 reached the rich country of the Chibchas of New Granada. There he found GONZALO QUESADA (*q. v.*), who had already entered this region, coming from Santa Marta. It is said that Quesada paid Federmann 10,000 *pesos* of gold to relinquish the conquest. The two leaders descended the river Magdalena together, and went to Spain; thence Federmann passed to Augsburg, where he immediately fell into trouble with the Welsers, owing to his desertion of Quesada. He lost his office, and narrowly escaped confiscation of his property. He then started for Spain to seek employment, but died, either in a shipwreck or shortly after reaching Madrid (about 1543). He wrote an account of his first exploration, which was published in German at Haguenau 1557, and there is a French translation in the Ternaux-Cómpans collection, 1837. HERBERT H. SMITH.

Fee [M. Eng. *fee*, *feoh* < O. Eng. *feoh*, cattle, property, money: Mod. Germ. *Vieh*, cattle: Goth. *faihu*, cattle. property; cf. Lat. *pecus*, cattle, money: Sanskr. *paçu*, cattle]: in its original signification under the feudal-law system of tenure, the allotment of land which a vassal received from his superior lord on condition of the performance of various services in his lord's behalf—especially of military service in time of war. (See FEUDAL SYSTEM.) It was used in contradistinction to *allodium*, which applied to land which a man owned in his own right, without any obligation to render service to another. But in the gradual modification of the law appertaining to the tenure of landed property the word "fee," while still retained, has undergone a change of signification, being used to designate the estate which a land-owner possesses. And by "estate" in this connection is meant not the property itself—though such an application of the term is common in popular parlance—but the interest which one has in the land as regards the nature and duration of his title. A fee therefore signifies an estate of inheritance—i. e. an interest in land which, on the death of the owner without a will, passes immediately to his heirs. When used without any word of description it has the same general extent of meaning as the phrases "fee-simple" and "fee-simple absolute." These words of designation appended are employed to indicate more specifically that the estate is to be enjoyed without any qualifications or restrictions limiting or tending to limit the indefinite duration and absoluteness of the tenure, and that it is indefeasible, in contradistinction to the terms "qualified fee," "determinable fee," etc., to be hereafter explained. A fee or fee-simple is the highest estate known to the law. Its mode of creation by deed at common law still exhibits the application of arbitrary rules derived from the feudal system, which derive their justification only from the circumstance that they are the result of the historic growth of the system of tenure, a factitious importance being given to them which seems, to a great degree, unreasonable when they are considered without reference to their origin. Thus it is absolutely essential that the word "heir" or "heirs" be employed in a deed in connection with the name of the grantee, or the only interest created will be a life estate. The purely arbitrary nature of this requirement has caused its abrogation in a few of the U. S. by statute. In wills. moreover, and in estates created under the doctrines of uses (see USES and TRUSTS), it has never been obligatory, since in these cases the object of legal interpretation has been to arrive at the true intent of the devisor or grantor, and to effectuate his real purposes without such precise regard to the forms in which they are couched. When a fee is conveyed to a corporation aggregate the word "heirs" is unnecessary, even in a deed, since it is not properly applicable; if the conveyance be to a corporation sole, the word "successors" should be substituted. The most important right which the owner of a fee-simple possesses is that of free and unrestricted enjoyment of the property, and an unlimited power to dispose of it at his own pleasure. Even if any language be inserted in the conveyance through which he received his title restricting his power of alienation, it is void and may be disregarded. This is not true, however, as to restrictions upon the mode of occupation, for there may be prohibitions against erecting buildings of a certain character or the use of the land for certain specified purposes which can not be transgressed. An owner in fee may transfer his entire estate to another, or he may carve out of it any inferior estate, such as a life estate or an estate for years, retaining in himself a reversion or creating a remainder in a third person, or he may make any other transfer he may think desirable. His interest may be seized and sold for the payment of his debts, either in his own lifetime or after his death, in exclusion of the claims of his heirs.

Estates in fee inferior to a fee-simple are termed "base" or "qualified" or "determinable" fees—i. e. estates of inheritance which are granted with qualifications or restrictions which may cause their defeasance. These assume various forms. Thus there may be a *fee upon limitation*, as an estate given to A until B goes to Boston. In such a case, if B ever goes to Boston the estate is at once defeated; if he never goes, the fee becomes absolute. A fee may be granted upon *condition*, as an estate to A on condition that he builds a market upon the land within three years. If the grantee fails to comply with the stipulation, the grantor or his heirs may re-enter after the condition is broken and recover the estate. Limitations are created by words of time; conditions, by terms in the nature of a proviso. There are also what are styled estates upon *conditional limitation*, as an estate to A until B goes to Boston, when the estate is to pass to C, some third person. No entry is required in such a case by the grantor to defeat the estate, as in the case of a condition, but on the occurrence of the event specified the estate is at once, *ipso facto*, vested in C, the grantee in the alternative. There was, moreover, a fee conditional at common law, which was afterward modified by statute into a peculiar estate termed a *fee tail*. This was created when an estate was given to a man and the "heirs of his body." In this case the grantee had a fee, but could not make disposition of it so as to defeat the right of the heirs designated. This particular restriction at common law was, in course of time, in England avoided by a resort to ingenious legal fictions, as by fines and recoveries; and in the United States there has been very generally an entire abolition of this form of estate, or so fundamental a change in it that this mode of limitation is made equivalent to a conveyance in fee-simple. On this general topic consult Washburn on *Real Property*; Williams on the same subject; Cruise's *Digest*; Kent's *Commentaries*, etc. See also ENTAIL and FEOFFMENT.

GEORGE CHASE.

Feejee: same as FIJI (*q. v.*).

Feeling: in its narrower meaning the sensation produced by an object on the sensory nerve, as hearing denotes the sensation produced by an object on the auditory nerve, sight the sensation produced by an object on the visual nerve, and so on. In its wider sense it comprises all the impressions received through the senses, as they all arise from the same general sensibility, which is merely particularized in the special sensory organs; but it refers to them not as far as they are sensations in the organs of sense, but as far as they are modifications of consciousness. Thus feeling is nearly synonymous with emotion, and the two expressions are often used synonymously, though emotion is more properly applied to the separate states of the feeling.

and feeling to the general capacity for emotions. Emotion refers to the shifting, changing surface of the feeling—feeling, to the steadily recurring sentiments rooting in the depths of our organization.

In this, its wider sense, feeling is one of the three forms under which the mind becomes conscious of itself, thought and will being the two others. The mind is conscious of itself only as far as it feels or thinks or wills, and it is never conscious of itself as performing more than one of these operations at a time, the two others being either dormant or absorbed. But although intellect, volition, and feeling thus form three very different manifestations of the mind, the distinction between them is nevertheless only an abstraction; in actual life no line of separation can be drawn. Thus feeling involves thought, and thought feeling. An impression on the sensibility remains a sensation in the organ of sense until an idea is sent out to meet it, to introduce it into consciousness, and to transform it into a feeling. All feelings—anger, pity, sorrow, love, joy, etc.—are charged with ideas. They express themselves not only through laughter and tears, but in winged words, and when they are strong they make men eloquent. Feelings which are untouched by intellect are not feelings; but instincts, cravings, appetites, desires, and so on. On the other hand, ideas are nothing but feelings which have been fixed in the memory, and by comparison, analysis, abstraction, and other processes of thinking, wrought into thoughts. A man has so many original ideas as he has living feelings, and no more; the rest are unoriginal, often borrowed, sometimes stolen. Ideas correspond to feelings, not only with respect to their number, but also with respect to their quality—nay, even with respect to their most delicate coloring. A man who feels hatred can rise in morals to the idea of justice, but never to that of love. All the ideas of Seneca were tinged by a cold, vain pride; those of Voltaire, by a malicious, cowardly joy; those of Hegel, by a broad, benign sympathy; those of John Stuart Mill, by a machine-like exactness and delicate subtleness. To draw a broad and unwavering line of demarkation between thought and feeling, or, generally, between the three manifestations of the mind, and to assign to each of them its own encircled sphere, as the old psychology tried to do, is impossible, and leads to grave errors. To discover and describe the delicate transitions or transfusions of thought, feeling, and will, as modern psychology tries to do, is of paramount importance for the right understanding of the mind, and has proved less difficult than it seemed at first sight.

Fees: See the Appendix.

Fehmarn: See FEMERN.

Fehmic or **Vehmic Court** [*fehmic* is from Germ. *Vehmgericht*; *fehme*, *vehme* < M. H. Germ. *veime*, secret tribunal; orig. obscure]: a tribunal of somewhat mythical origin that flourished in Germany during the Middle Ages. It is claimed by some that Charlemagne first organized these courts, and by others that they came down from the ante-historic Germans; but whether either of these statements is correct or not, they first appear in history during the anarchical days which followed the expulsion of Henry the Lion from his estates by the Diet of Wurzburg in 1180. This court was composed of "initiated" members (*Wissende*), who were sworn to secrecy by a tremendous oath. The Archbishop of Cologne (as Lord of Westphalia) and the emperor were at least nominal members. The courts were presided over by a *Freigraf*, or free count. Their tribunals were either open—held by day in the open air—or secret, the latter being held for the trial of the more serious offenses. The Fehmic courts were at first administered in a fair and upright manner, and enforced a respect for law and order at a time when society was in confusion, but they finally came to have a most extensive and dreadful authority. Not only feudal barons were cited before this irresponsible tribunal, but at least in one instance the emperor himself. In the Pact of Westphalia (1371) they were recognized as lawful. In 1438 the Emperor Albert II. attempted to suppress them. In 1461 so dreadful was their influence that many nobles, prelates, and cities of Germany and Switzerland combined to resist their power. In 1495 Maximilian I. gave them a new code, which greatly reduced their authority. In 1568 their last open court was held near Celle in Hanover, but in Westphalia, their true home, these courts nominally existed until 1811, holding secret meetings, but were suppressed in the latter year by Jerome Bonaparte. Born of a stern necessity, the Fehmic courts came in time to be a serious evil, and are chiefly remembered for the excessive cruelty of their punishments.

Feia, fā-yaā' (Port., ugly): a lake of Southeastern Brazil; in the eastern part of the state of Rio de Janeiro, near the coast. It is about 20 miles long, has an area of 190 sq. miles, and is so shallow that the waves make the waters constantly turbid. The little river Macabú and other streams flow into it. The Lagoa Feia abounds in fish. It is the largest of numerous lakes forming a system along this part of the coast; they are properly lagoons, kept fresh by barrier sand-bars, are united by an intricate network of channels, and part of their water eventually flows N. to the Parahyba river. HERBERT H. SMITH.

Feigned Diseases: a term used to cover all the manifestations coming under the head of the technical terms "malingering" in English and "simulation" in French and German. As commonly understood, these terms apply to the pretense that one has a disease, an injury, or a defect, which is not present. Such pretending has been common from the earliest epochs of human history. The most ancient case on record is said to be mentioned in the book of Genesis, chap. xxxi., though it may be unjust to assume that the asserted condition in that case did not exist. Another case is that of David, who when fleeing from King Saul took refuge with Achish, King of Gath, and then made his escape from a rather hazardous situation by pretending to be mad or insane. Still another interesting case, from the historical standpoint, is that of Pope Sixtus V., who is said to have pretended to be in a decline when he was a candidate for the papal chair, and unable to speak above a whisper or without a violent spell of coughing, but, as soon as he was elected, threw away the staff upon which he had been wont to lean and intoned the *Te Deum* in a voice which astonished all who heard him.

The earliest medical writer to speak of malingering is said to be Hippocrates; but it requires some forcing of the statement he makes, in his book *On Airs, Waters, and Places*, in regard to the mildness and cowardice of the Asiatics, to find in them a charge of malingering or of mutilating themselves in order to escape military service. Galen (131–200 A. D.), however, devoted a book to this subject, entitled *Quomodo morbum simulantes sint deprehendendi* (How those who simulate disease are to be detected), and described a number of conditions feigned or imitated by malingerers, such as spitting of blood, inflammation of the knee, pain, and insanity. Among a host of later writers may be mentioned Ambroise Paré (1573), Sylvaticus (1594), Zachias (1628), Gavin (1843), Bartholow (1864), Keen (1864), and Boisseau (1870).

Systematic writers have adopted various classifications for the conditions included under the terms considered. The best of all is that of Gavin, of London, who divides them as follows:

I. Fictitious diseases. $\left\{ \begin{array}{l} a.\ \text{Asserted.} \\ b.\ \text{Imitated.} \end{array} \right.$

II. Exaggerated diseases.

III. Factitious (provoked) diseases.

Class I. includes cases in which there is merely a false claim that disease or injury is present, or, in addition, an attempt to imitate the symptoms of disease or injury. In Class II. the attempt at deception consists in exaggerating the symptoms of a disease or injury actually existing. In Class III. are cases in which disease or injury is self-inflicted. To these classes of Gavin might well be added a fourth, attributed diseases, covering cases in which the results of an old injury are charged to a recent accident—a form of imposture which is not very rare after railway accidents.

For the purposes of this article mere mention will suffice for all the forms of "simulation," except those of Class I., which includes all to which the term "feigned disease" could with strict propriety be applied. Of these there are enough in numbers and variety to occupy much space. Among the most common are feignings of insanity, epilepsy, paralysis, loss of consciousness, inability to eat, deafness, and defects of sight. It is not unlikely that many of the cases of peculiar nervous diseases studied so minutely by Charcot and his followers in Paris (grave epilepsy, hystero-epilepsy) were cases of voluntary or involuntary imitation or simulation.

Some examples of malingering require an extraordinary amount of determination, shrewdness, and persistency. A case of pretended tetanus is on record which compelled the malingerer to maintain himself for hours in the most trying and exhausting attitudes, and to submit to most heroic methods of treatment. The malingerer went from hospital to hospital in London, and was the subject of so many demonstrations and lectures to students that he gradually improved his acting, rectifying in one hospital the anomalies in his case which he had heard pointed out in the preceding one, and finally received the ministrations of a clergyman in view of his expected death before his imposture was discovered.

The motive for malingering is usually a desire to avoid unpleasant or dangerous situations, or to secure money or sympathy or notoriety, or to punish others through their feelings. Thus in all countries and all times persons liable to military or naval service have pretended to be unfit for such service, and those already engaged in it have sought to secure discharge or exemption from the performance of duty by like pretending. In European countries especially, and in times of more rigorous exactions, attempts to escape military duty have been so widespread and so ingenious that stringent laws have been adopted to punish not only those making such attempts, but also those who in any way aid or abet them. The pretense of insanity is an altogether too familiar resource of criminals, and especially of murderers. In hospitals patients often endeavor to enlist special sympathy or to secure unusual privileges by feigning curious disorders, peculiar feebleness, or pain. In a case in the Philadelphia Hospital, under the care of the writer, a young woman repeatedly submitted to painful and dangerous operations in support of her pretense of excruciating pain in order to get morphia. In schools, almshouses, reformatories, and prisons the same mode of imposture is practiced, while beggars on the streets and pampered women alike avail themselves of this method of securing their desires.

The detection of malingering or simulation is sometimes easy, but often it is very difficult. Ingenuity often plays a more important part in unmasking an impostor than does mere skill in medicine. A French surgeon once watched a pretended epileptic in a fit, and when it subsided put his hand on the patient's heart and said: "It is all over with him. Carry him to the dead-house." This brought the man out of that attack, and frightened him out of having any other.

An exercise of acumen was also shown in the case of a pretended deaf-mute, who was exposed by the Abbé Sicard, director of the Institute for Deaf-mutes in Paris, who observed that the mistakes the pretender made in writing were phonetic—that he wrote as he *heard*, and not as he *saw*. In cases of pretended defects of vision the instruments and methods of examination of modern oculists furnish a very strong defense against deception. For example, when one eye is said to be blind, the examiner places in front of the eyes of the pretender a pair of spectacles, one lens of which contains a prism with its base turned up or down, and then makes him look through an aperture at a hitherto concealed candle. He is then asked what he sees; and if he says he sees (as he does, if he is using both eyes) two candles, his fraud is discovered. Or the eye admitted to be sound is covered with a red glass, and he is asked to read lines written in green upon a black ground. If he can do this, he is known to be reading with the eye said to be defective; because at a certain distance green rays passing through a red glass appear black.

Countless other methods have been employed in dealing with malingerers. Some of them were such as would test the fortitude of the suspect. In earlier times these used to be in great favor, and were often carried to a barbarous extent. But modern civilization and the advance of medical science have led to the dismission as abhorrent, or the abandonment as unnecessary, of every method which is cruel or which may be injurious. It is regarded as proper, however, to apply a test which is painful, *provided* the procedure would be beneficial if the pretended disease were actually present. For example, a blister, or even the actual cautery (burning with the red-hot iron), might be used in a case of asserted stiff-knee.

Fortunately, with the general elevation of the human race and with the improved conditions of military and naval service, malingering is no longer as common as it once was. But there still remain sufficient occasions when cupidity or fear prompt to this form of imposture to make it necessary to recognize its existence and to guard against it. Modern times have also furnished a comparatively new form of this sort of fraud, of which corporations are the special victims—the nervous affections following railway accidents. The obscurity of the processes of many injuries of the nervous system makes it very difficult at times to determine whether a claimant is a real sufferer or a pretender, and medico-legal experts are often unable to decide surely whether or not a particular claimant is a real sufferer or an impostor. In all such cases it is important for those who are called upon for an opinion to weigh carefully the motives for deception which may be present, so to give them due and yet not undue weight. Justice requires that the expert in these cases shall not make the mistake of regarding himself as an inquisitor, and that he shall always be willing to admit uncertainty when he feels it. A wise conclusion in this matter is recorded by an eminent German expert, Dr. L. Bruns, in Schmidt's *Jahrbücher*, 1891, No. 4. He had had submitted to him the opinions of four physicians, two of whom expressed a positive opinion that a case was one of malingering; one said positively it was not; and one wrote: "Non liquet: I do not know whether the patient lies or tells the truth." "This," says Dr. Bruns, "was the only just opinion."

Such a prudent attitude may be assumed without danger of mortification by any medical man who is at all familiar with the facts on record in regard to malingering; and justice to all concerned makes it important that no one should hastily formulate as opinions mere suspicions, lest he find himself in the quandary of choosing between retracting what he has said or doing a wrong to the innocent.

CHARLES W. DULLES.

Feijó, fā-zhō', DIOGO ANTONIO: Brazilian statesman; b. in São Paulo, Aug., 1784. He took orders, and was a priest in Parahyba, Campinas, and Itú. In 1822 he was deputy of São Paulo to the Cortes at Lisbon, and was one of the five Brazilian deputies who left that body on the declaration of independence. He was deputy 1826–33, and a leader of the liberals; in 1827 he presented a bill for the abolition of celibacy in the clergy. From July 4, 1831, to July 26, 1832, he was minister of justice, preserving order under very difficult circumstances. In July, 1833, he entered the Senate, and next year he was elected regent of Brazil during the minority of Pedro II.; he retained his post from Oct. 12, 1835, until Sept. 18, 1837, in an almost constant struggle with the conservatives. In 1842 he took the leadership of the liberal revolt at Sorocaba, and for a short time was under arrest. The Padre Feijó was noted for his virtue and austere adherence to principle. D. at São Paulo, Nov. 10, 1843. HERBERT H. SMITH.

Feints: See FENCING.

Feith, RHIJNVIS: poet; b. at Zwolle, Overyssel, Holland, Feb. 7, 1753; studied law at Leyden, but returned to his native town 1772; was elected burgomaster 1780, and became a prominent member of important literary societies. His work was singularly successful, and won for him the highest honors from his countrymen. His life was one of remarkable prosperity, but his poems deal with emotions of melancholy and despair to a greater extent than those of any other Dutch poet. Though this provoked adverse criticism, and was characterized by many as sentimentalism, Feith was undoubtedly the most popular poet of his time. D. at Zwolle, Feb. 8, 1824. His earliest important work was *Julia*, a novel written in the style of Werther (1783). Then followed *Thirza* (1784), a tragedy; *Ferdinand and Constantia*, another novel, and the *Patriots* (1785), works which were publicly crowned at Leyden. *Het Graf* (*The Grave*), published in 1792, was a didactic poem of a gloomy and sentimental tone. From 1796 to 1814 appeared five volumes of *Odes and Miscellaneous Poems*, among which are many specimens of his best style, notably his spirited patriotic lyrics. *De Ouderdom* (*Old Age*), another didactic poem, appeared in 1802. In prose he has left *Brievenover verscheiden Onderwerpen* (*Letters on Different Subjects*, 1784–94).

Felaniche, fā-lăă-neech', or **Felanitx**: an old town of the Spanish island of Majorca (see map of Spain, ref. 16–L). It has considerable trade in wine, brandy, and fruit. On a neighboring mountain is the old castle, with its subterranean vaults constructed by the Moors. Pop. 11,000.

Felch, ALPHEUS, LL. D.: lawyer; b. in Limerick, York co., Me., Sept. 28, 1806; graduated at Bowdoin College 1827, and became a lawyer of Michigan, whither he emigrated while still very young; sat in the State Legislature 1836–37; bank commissioner 1838–39; auditor-general of Michigan; was a judge of the State Supreme Court 1842-45; Governor of Michigan 1846–47; U. S. Senator 1847–53; a commissioner of California land claims 1853–56 under the treaty of Guadelupe Hidalgo, and was elected a delegate to the Chicago convention of 1864, in which he took an active part. Retired from practice 1877. Professor of Law in Michigan University 1879–83. Received the degree of LL. D. from Bowdoin in 1877. At the time of his death in Ann Arbor, Mich., June 13, 1896, he was the oldest surviving member of Michigan Legislature from Monro County; the only surviving bank commissioner of the State; oldest surving auditor-general of the State; oldest surviving judge of the Supreme Court of Michigan; and the only surviving member of the California Land Company.

Feldkirch, felt'keerch: manufacturing town of Austria; in the Vorarlberg; 20 miles S. W. of Bregenz (see map of Austria-Hungary, ref. 6–A); the seat of a bishop, suffragan to the Bishop of Brixen, and Vicar-General of the Vorarlberg. It has an important Jesuit educational institution (Stella Matutina) and a Capuchin cloister, and is the seat of important courts, etc. Its manufactures are varied and important. Mar. 22 and 23, 1799, it was the scene of the victory of the Austrians under Jellachich over the French under Massena. Pop. (1890) 3,811.

Feldspar, or **Felspar** [corruption of Germ. *Feldspath*, under influence of Eng. *spar*]: a term applied to a family of minerals embracing many species, which crystallize in several systems. In chemical composition they all agree in being silicates of alumina, with silicates of other bases, either soda, potash, or lime. By some authors the term is restricted to one species, the common potash feldspar, or orthoclase. Popularly the term is also applied to albite, a soda feldspar, and to labradorite and oligoclase, soda-lime feldspars, etc. Feldspars enter largely into the composition of all granitic and of many metamorphic rocks, and form the chief element of porphyries and volcanic rocks. In their decomposition they are the source of clay. Moonstone and lapis-lazuli are members of this family valued in the arts, and feldspar is also used as a glaze for porcelain.

Félibres: See PROVENÇAL LITERATURE.

Felice, fā-lee'chā, FORTUNATO BARTOLOMMEO, de: author; b. at Rome, Aug. 24, 1723; studied at Rome and Naples; eloped with a nun to Switzerland; became a Protestant and a printer; editor and teacher at Yverdun; published Italian and other translations of the leading philosophical works of that period; wrote some original works upon natural, national, and civil law, and was the principal editor of an *Encyclopédie* (in 58 vols., 1770–80) based upon the great French *Encyclopédie*. D. at Yverdun, Feb. 7, 1789.

Felicis'simus: a deacon of Carthage; ordained by the enemies of the bishop Cyprian while he was absent in time of persecution, between Feb., 250 A. D., and Apr., 251 A. D. He was a man of wealth, of talents, of energy, and of influence. As soon as he returned to Carthage, Cyprian summoned a council which excommunicated Felicissimus and the presbyters who sympathized with him. Refusing to submit, the party chose one of their own number (Fortunatus) in place of Cyprian as bishop. Felicissimus was deputed to represent their cause at Rome and to sustain charges against Cyprian. This project failed, and the schism soon came to an end. See *Cyprianic Epistles*, 38 and 55, for the character of Felicissimus, drawn in the darkest colors.

Another Felicissimus was a friend of Cyprian, and first to suffer in the Decian persecution. It is uncertain whether he is the St. Felicissimus named in the martyrologies.

Felic'itas, SAINT: a martyr; put to death, with her seven sons, at Rome under Antoninus Pius (about 150 A. D.). All were arraigned together before the tribunal of Publius the prefect. To the question whether they would sacrifice to idols, they replied by a firm refusal, fearlessly confessing their Christian faith. The officer informed the emperor of their refusal, and by him they were left to the sentence of the judges, who ordered the sons to be put to death by diverse punishments, but the mother to be beheaded.

Fel'idæ [Mod. Lat. deriv. of Lat. *felis*, cat]: a family of carnivorous mammals (typical genus *Felis*) comprising the cats; distinguished by the reduction of the true molars to one on each side of either jaw, by the absence of an alisphenoid canal, thirteen dorsal vertebræ, and digitigrade feet provided, with the exception of the cheetah, with retractile claws. The skeleton shows special modifications for a predatory life. The wide zygomatic arches allow room for the powerful muscles which move the jaws; the canine teeth are for piercing and tearing; the digitigrade feet give an elastic, noiseless step; the hind limbs are adapted for leaping, while the powerful fore legs have great freedom of motion for striking, grasping, or tearing. The family is the most highly specialized of the *Carnivora*, and its members, almost without exception, live on the fresh flesh of animals which they have killed themselves. For various kinds of cats see CHEETAH, JAGUAR, LEOPARD, LION, LYNX, OCELOT, PANTHER, PUMA, and TIGER. F. A. LUCAS.

Felix I.: saint; succeeded Pope Dionysius Jan. 5, 269 A. D. In the persecutions under the Roman Emperor Aurelian he was condemned to die, but expired in prison Dec. 30, 274.—FELIX II., pope; chosen by the Arians or by the Emperor Constantius in 355, during Liberius's exile, upon whose return he was expelled. D. Nov. 22, 365, and was canonized by the Romish Church.—FELIX III., pope in 483 A. D., was a native of Rome and great-grandfather of Gregory the Great. His condemnation of Acsius, Patriarch of Constantinople, accused of heresy in 484, occasioned the first schism between the Eastern and the Western Churches. D. Feb. 24, 492.—FELIX IV., pope in July, 526, appointed by Theodoric, King of the Goths. D. Oct., 530.—FELIX V., pope or antipope. Duke Amadeus of Savoy abdicated his ducal crown in 1433, and retired to Ripaille on Lake Geneva to live as head of a monastic community. But he was elected pope by the Council of Basel Nov. 5, 1439, and consecrated July 24, 1440. Failing to get recognition from the great powers, he renounced the pontificate Apr. 9, 1449, became Cardinal of San Sabina and papal general-vicar for Savoy, Basel, Strassburg, and contiguous parts, and d. in Ripaille, Jan. 7, 1451.—FELIX, Bishop of Urgel, in Catalonia, in the eighth century; was a man of great acuteness and learning and formulated the "Adoptian heresy"—i. e. that Christ, as man, was merely the adopted son of God. He was banished about 800, and died at Lyons about 818.

Felix (in Gr. Φῆλιξ), ANTONIUS: a freedman of the Emperor Claudius, whence he was also, according to Suidas, called Claudius; a brother of the powerful freedman Pallas, through whose influence with the emperor and the Empress Agrippina Felix was appointed as procurator of Judæa in 52 A. D. Throughout the whole of his administration he had to contend against riots and seditions of every sort, stirred up by bandits, the so-called *sicarii*, religious zealots, and false prophets. His suppression of them was distinguished by a cruelty and rapacity which defeated its own end and was productive of more crime and disturbance than ever. It was this Felix to whom St. Paul was sent for trial after his arrest at Jerusalem, and before whom he so "reasoned of righteousness, temperance, and judgment to come" that "Felix trembled." Nevertheless he was detained by him for two years, and was finally released by Felix's successor, Festus. In A. D. 60 (or 61) he was succeeded by Festus, whereupon the leading Jews of Cæsarea went to Rome and brought accusation against him before the emperor (probably with special reference to the part he had played in the suppression of the riots between the Jewish and Syrian inhabitants of Cæsarea), but through the intercession of his powerful brother, the freedman Pallas, he escaped punishment. Cf. esp. Josephus, *Antiq. Jud.* (xx., 7 and 8) and *Bel. Jud.* (ii., 12 and 13). G. L. HENDRICKSON.

Felix, MARCUS MINUCIUS: commonly called MINUCIUS FELIX; an eloquent Roman lawyer and one of the earliest Christian writers, perhaps before Tertullian, although his period is variously set between 170 and 303 A. D. Wrote the dialogue *Octavius*, designed as a popular defense of Christianity, and remarkable for its choice diction. Possibly he came from Africa. See Wölfflin, *Archiv für Lat. Lexikographie*, vol. vii., pp. 468–484. M. WARREN.

Fellah, fel'lā, plur. **Fellahin**, -heen [Arab., plowman, peasant]: one of the laboring class in Egypt. The fellahin are mostly Mohammedans, but a few of them are Copts. Except the slaves, they are the lowest class of the population. Politically and socially they have considerably improved under the British *régime*. They form 61 per cent. of the Egyptian people. They are of mixed Coptic, Arabian, and Nubian stock. They are licentious, idle, and obstinate from the effects of many ages of grievous oppression. The name *fellahin* is also given to the laboring classes of other Mohammedan countries.

Fellat'as, or **Fu'las**: a Mohammedan people of the Western Sudan in Africa, remarkable for their enterprise, intelligence, and religious zeal. They are a foreign race distinct from the Negroes, have many tribes, several shades of color and varieties of form, probably from the fact that they have blended with subject races. They cultivate Mohammedan learning enthusiastically. Their history is quite obscure. Sokoto is their principal state, but they are the predominant people of several Sudanese lands, and are found as far E. as Darfur.

Fellenberg, fel'len-bărch, PHILIPP EMANUEL, von: educator and statesman; b. in Berne, Switzerland, June 27, 1771; was a descendant on the mother's side of Admiral Van Tromp. In youth he imbibed in some measure the philanthropic views of Pestalozzi, his father's friend. Fellenberg studied at Colmar and Tübingen, and a visit to Paris just after Robespierre's death convinced him that a better public education was necessary to the safety of society. He opposed the French in their occupation of Switzerland, for which cause he was banished, but after his return was employed in important diplomatic, political, and military offices. After failing to secure government aid in his plans, he founded in 1799 his famous educational and manual-labor establishment on his own estate at Hofwyl, near Schönbühl, in the canton of Berne, and to this school he consecrated all his large fortune. In 1804 Pestalozzi removed his Burgdorf school to the old monastery of München-Buchsee, adjoining Hofwyl. Here the teachers gave the chief direction to Fellenberg, as Pestalozzi said, "Not without my consent, but to my profound mortification." In 1805 Pestalozzi accepted a call to open a school at Yverdun. In 1807 Fellenberg established a scientific department, and in 1808 a normal school and an agricultural institution, where scientific agriculture was taught and practiced and farming implements manufactured. The Hofwyl institution flourished, and before Fellenberg's death there were in it ten distinct departments of instruction. Children of all ages, the rich and poor alike, were received. The wife and nine children of Fellenberg assisted him in his work. He died at Berne while grand bailiff, Nov. 21, 1844. A few years after his death his establishment was abandoned. Fellenberg was in temper and method almost the exact opposite of Pestalozzi, though he pursued the same ends. The ruling spirit of his school was common sense. Order was there as prominent as the lack of it was at Yverdun. See Payne's *Lectures on the History of Education.* Revised by C. H. THURBER.

Fellows, Sir CHARLES: b. at Nottingham, England, in 1799; made four expeditions into Asia Minor; collected the Lycian Marbles, now in the British Museum; was knighted in 1845. Author of *Journal of an Excursion into Asia Minor* (1839); a *Journal* (1841) of his second expedition; *Xanthian Marbles* (1843); *Account of an Ionic Trophy Monument* (1848); *Coins of Ancient Lycia* (1855), etc. The rich archæological remains of Lycia were quite unknown until described by him. D. at Nottingham, Nov. 8, 1860.

Fellow Servants: two or more persons who are subject to the same general control, and engaged in the same pursuit. The rule of law is that one who engages in the employment of another for the performance of specified duties and services, for a compensation, takes upon himself the ordinary risks and perils incident to the performance of such services, including the perils arising from the carelessness and negligence of those engaged in the same employment. So that while a master is ordinarily liable to a third person for the wrongful acts of his servant if the acts are done in the execution of the master's business within the scope of the servant's employment, yet the master is not liable if the person injured is a fellow servant with him who worked the injury in the manner above defined. The test for determining who are fellow servants does not consist in the grade or rank of the offending or injured servant, but in the character of the act done by the offending servant. If the act is one which the law implies a contract duty upon the employer's part to perform, then the offending employee is not a servant but an agent, and the master's liability is clear. A master who knowingly employs and retains an incompetent servant is liable for injuries done by such servant to a fellow servant, if it appears that the injured servant did not know and did not have the means of knowing of the incompetency of his fellow servant, and provided the injury is the result of the fellow servant's unskillfulness or incompetency. If a servant is generally known to be incompetent the master is chargeable with negligence in not knowing what that reputation is. If the master originally used due care in the selection of the servant, and subsequently obtains knowledge of his unfitness, but continues him in his employment, he makes himself thereby liable for injuries resulting to fellow servants from such unskillfulness. In Great Britain, and in some of the commonwealths of the U. S., statutes have been passed on this subject changing the common-law rule, and making the master in some cases liable for injury caused to employees by the negligence of a co-employee. See MASTER and SERVANT.

HENRY WADE ROGERS.

Fellowship: in the universities of Oxford, Cambridge, Durham, and Dublin, a position held by the fellows (*socii*) of a particular college. The fellows were originally poor students (chiefly of divinity) who received the income of the fellowship as a means of support, but when they obtained a sufficient benefice, or became owners of property beyond a certain amount, or by marriage signified their abandonment of the Church, they lost the fellowship. The same causes, with some modifications and exceptions, will vacate a fellowship at present. Now, however, the fellowships are rewards for eminent scholarship, yielding in some cases a very handsome income, besides other valuable perquisitites. Recent legislation has much simplified the ancient system of fellowships. The system of fellowships has extended rapidly among colleges and universities in the U. S. The conditions under which they are awarded vary in different institutions. They are, however, always given to college graduates of superior attainments, to enable them to pursue advanced studies. Generally they are tenable for a year only, though holders may be re-elected. The stipends are never large, $500 per annum being the usual amount. The fellows hold the most dignified position in the student body, and the ranks of the faculties are apt to be recruited from them. In a number of institutions in the U. S. the trustees are called fellows. Revised by C. H. THURBER.

Felltham, or **Feltham**, OWEN: author; b. in Suffolk, England, 1608; was for a time an inmate of the Earl of Thomond's household. Felltham wrote about 1628 his *Resolves, Divine, Moral, and Political*, a book of moral reflections which was very popular in the seventeenth century, and has been often reprinted. D. in 1677.

Fe'lo de se [Med. Lat., a felon concerning himself, murderer of himself; *felo* is the Lat. form of a Romance word; cf. Ital. *fellone*, Fr. *felon*, ultim. of Germ. origin]: one who commits suicide. See SUICIDE.

Felon: See WHITLOW.

Felony [O. Fr. *felonie*, deriv. of *felon*; cf. Ital. *fellone*, outlaw, a word of German origin]: as a term of the English common law, an offense the commission of which was attended with a forfeiture of the wrongdoer's lands, goods, or both; distinguished from a *misdemeanor*. The principle of classification in accordance with which all crimes were divided into the two classes of *felonies* and *misdemeanors* did not depend upon any definite inherent peculiarity by which the offenses in one category were separated from those in the other, but merely upon the difference in the modes of punishment adopted. Death was in a large number of instances superadded to forfeiture in the case of felonies, but was not a distinguishing characteristic of this grade of offense. The common belief that in order for a crime to be felonious it must be one for which capital punishment is inflicted, is entirely erroneous. In the law of Great Britain there have been some important changes made in the laws concerning forfeiture, but the term "felony" retains its previously established signification, and no offense comes under this designation to which forfeiture is not annexed as a penalty. Goods and chattels are forfeited upon conviction for any felony, but in the case of lands conviction alone is not sufficient, but sentence of attainder must be pronounced. (See ATTAINDER.) By attainder for felony the offender forfeits the profits of all freehold estates during life; if the offense be *murder*, he also forfeits, after his death, all lands held in fee simple to the crown for a year and a day. (See FORFEITURE.) In the U. S., where the nature and punishment of crimes are generally determined by statutory provisions, there is no universally recognized meaning given to the word "felony." Some States which have still retained it in use give to it a specific definition, employing it to designate crimes involving a certain kind of penalty, but making the penalty of a different character from that by which its meaning was originally determined. Thus in New York any offense punishable by death or by imprisonment in a State prison is a felony. In a few States the use of the term is entirely discarded, and if it be employed at all in legal proceedings it is without definiteness and precision of meaning. Forbearing to prosecute a felony for a consideration constitutes the crime of COMPOUNDING OF FELONY (*q. v.*). See the article CRIME.

GEORGE CHASE.

Fel'sing, JAKOB: engraver; b. at Darmstadt, Germany, in 1802; wrought in Italy ten years, and then, in 1832, obtained at Darmstadt the title of engraver to the court. *The Marriage of Saint Catherine*, after Correggio, *Holy Family*, after Overbeek, are among his best works. D. at Darmstadt, Mar. 29, 1875.

Felsite, or **Felstone**: a hard flinty rock which has about the same chemical composition as granite, but which to the unaided eye appears homogeneous. The microscope shows such rocks to be composed of the same mineral ingredients as granite, but in an extremely finely divided state. They are therefore called cryptocrystalline. Such rocks are identical with the base or groundmass of the porphyries, with which they are genetically closely related, although they are free from porphyritical crystals. They have originated through the devitrification of ancient glassy rocks, or were produced by the original crystallization of a molten magma. They are frequently banded, and may be of any color. The banding may be due to original flow structure in the viscous mass, or it may be the result of pressure and shearing on the solid mass. Possibly similar rocks may also be produced from acid volcanic ashes or other sedimentary material, and may then have a true stratification. Felsite is also known as *petrosilex* or *halleflinta*. GEORGE H. WILLIAMS.

Felspar: See FELDSPAR.

Felstone: See FELSITE.

Felt [O. Eng. *felt*: Germ. *Filz*. Cf. Lat. *pilus*, hair, and Gr. πῖλος, felt, fez]: a stuff composed of wool, fur, or hair, of which the fibers are so entangled and interlaced that they can not readily be separated. Felt is an article which has long been known. Homer and Hesiod distinctly mention it. It was a common material for caps, hosiery, floor-cloths, tents, and cloaks. It has long been known in the East, and the nomads of the desert largely occupy tents of felt. There is, however, a tradition that St. Clement discovered felt while on a pilgrimage. Having put a bat of carded wool into each shoe to save his feet from blistering, he found at his journey's end that moisture and friction had converted the wool into felt.

Waste wool is largely employed for felting. It is first deprived of its oil, then carded and placed in a machine, where it is kept wet with hot water and subjected to a process of beating, by which the fibers are made to move upon each other until the interlocking of their serrations and the curling of the fiber itself unite the whole into a compact sheet of felt. The *fulling* of cloth is but a partial felting of wool already woven. Felted wool is used for carpets (often beautifully printed), carpet-covers, coarse hats, carriage-linings, and even for cloaks and other garments. The cheapest woolen rags, etc., are worked into felt for covering steam-boilers. This is an excellent non-conductor, and greatly diminishes the waste of heat. Roofing felt is a coarse kind, usually coated and filled with coal-tar and sometimes with tar and powdered slate. Felt is also used for sheathing walls, and is useful as a non-conductor of heat. Felt for hats is made of the fur of nutria, raccoons, beavers, conies (rabbits), etc., and is generally mixed with some Saxony or other felting wool. The heap of fur is struck with a bowstring until it falls into an even layer, and it is felted by working it with the hands in a soapy liquid. Machinery is also sometimes used in this process.

Felt, JOSEPH BARLOW, LL. D.: antiquary; b. at Salem, Mass., Dec. 22, 1789; graduated at Dartmouth College 1813; was pastor of Congregational churches at Sharon and at Hamilton, Mass., from 1821 to 1824, and from 1824 to 1834, respectively. In 1846 he completed the classification and binding of the archives of the State of Massachusetts, for which he had been commissioned by Gov. Everett in Apr., 1836. He also procured from the English archives duplicates of records which had been lost. He was president of the New England Historical and Genealogical Society 1850–53, besides holding other offices in kindred institutions. *Annals of Salem* (1827); *Historical Account of Massachusetts Currency* (1839); *Ecclesiastical History of New England* (2 vols., 1855–62), etc., were among his publications. D. at Salem, Sept. 8, 1869.

Felton, CORNELIUS CONWAY, LL. D.: scholar and author; b. at West Newbury, Mass., Nov. 6, 1807; graduated at Harvard College 1827; in 1829 he was appointed Latin tutor at Harvard College; in 1830 Greek tutor at the same institution. In 1832 he became Eliot Professor of Greek there, and July 19, 1860, was inaugurated president of the college. Member of the American Academy of Arts and Sciences, and regent of the Smithsonian Institute. Among his numerous publications may be mentioned: *Homer, with English Notes and Flaxman's Illustrations* (1833); Aristophanes, *Clouds* (1841); *Birds* (1852); Isocrates, *Panegyricus* (1849); Æschylus, *Agamemnon* (1849); Menzel's *German Literature* (translation, 3 vols., 1840); *Ancient Literature and Art*, in conjunction with Sears and Edwards (1843); revision of Smith's *History of Greece* (1855); *Selections from Modern Greek Writers* (1856); translation of Guyot's *Earth and Man* (1849); *Life of Gen. Eaton*, in Sparks's *American Biography*. D. at Chester, Pa., Feb. 26, 1862.

Revised by ALFRED GUDEMAN.

Feluc'ca [Ital. *felucca* (whence Fr. *felouque*, Germ. *Felucke*), from Arab. *falūka*, deriv. of *fulk*, a ship]: a vessel used in the Mediterranean Sea, having a small tonnage, light draught, and great speed with a light wind. These vessels have from ten to eighteen sweeps, or large oars, carry lateen sails, and have frequently a rudder at each end so that they may be used as "double-enders" and may reverse their course without tacking or veering.

Feme Coverte: See MARRIED WOMEN.

Fem'ern, or **Feh'marn**: a very low, perfectly level, marshy, but fertile island in the Baltic, belonging to Prussia, and separated from Holstein by a narrow and shallow sound. It has two towns, Burg and Petersdorf. Pop. 9,800.

Fe'mur [Lat., thigh-bone]: in the vertebrate skeleton the proximal bone of the posterior extremity, interposed between the innominate bone and the tibia and fibula, the bones of the leg. It has (1) a globular *head*, rotating within the acetabulum or socket of the hip, and joined by a (2) *neck* to the main femur or (3) *shaft*; also (4, 5) a *greater* and a *lesser trochanter*, prominences for attaching the rotating muscles and giving them leverage; (6) a *linea aspera*, or "rough line" running lengthwise for the attachment of muscles; and (7, 8) *outer* and *inner condyles*, at the lower end, affording articulating surfaces for union with the bones of the leg. The femur in man is popularly called the thigh-bone. The term *femur* is also applied to a part of the leg of an insect. See ENTOMOLOGY.

Fences: See the Appendix.

Fencing [deriv. of *fence*, an abbrev. of *defence*]: properly, the art of using a weapon as a means of defense as well as attack. When men covered with armor and carrying large shields assailed one another with swords, halberds, axes, or other cutting and piercing weapons, there was but little attempt at *fencing*; the sword-play, etc., of the time had to do chiefly with ways of reaching the flesh in spite of its coverings and guards. But men undefended, or almost undefended, carrying only small bucklers and perhaps head-pieces, used a kind of fencing called sword-and-buckler play, in which the parrying or *fending* was done chiefly but not wholly by the buckler. The adaptation of this to the supposed needs of the noble or knightly class at the close of the fifteenth century, when armor was less commonly worn than before, took the form of rapier and dagger play. The rapier, a heavy, straight, double-edged, and pointed sword, over 4 feet long and weighing from 2½ to 3 lb. without its sheath, was used chiefly for the thrust; rarely, though sometimes, to cut with the edge. Parrying was chiefly done by means of the dagger held in the left hand. In default of the dagger, a cloak wrapped around the arm enabled the arm alone to put thrusts aside. In the sixteenth century many works were published with copious illustrations to explain the numerous systems of fence which different Italian, Spanish, and French "masters of arms" had devised. The dagger, though chiefly for warding, would sometimes give the thrust; so the rapier would sometimes parry, and some systems supposed the use of two swords of equal length, even as the Chinese sometimes carry two swords of the same pattern in one scabbard, for very similar fencing. There was also an elaborate system of fencing with the huge two-handed sword of the Swiss mountaineers, the Highlanders of Scotland (this being the original and proper *claymore*), and of many kinds of foot-soldier all over Europe. There was also a system of fencing with the halberd, not unlike that used by the Japanese, as their own illustrated handbooks show, and somewhat like modern practice with the bayonet. Bayonet-fencing has been slowly developing ever since the bayonet was finally arranged so as to remain fixed to the musket and not interfere with loading and firing.

During the reign of Louis XIV. the small sword proper replaced the heavier weapons of earlier times, the two-handed fence was abandoned, and the modern system was slowly developed. The small-sword, when once it came into use, was adopted as the fairest weapon for dueling; and though to the custom of wearing it may be charged the disposition to indulge in violence, many desperate encounters in which innocent persons sometimes suffered, and the loss of valuable lives, it must be said that the practice of DUELING (*q. v.*), which had previously been so conducted that every unfair advantage was taken and allowed, and with a revolting display of ferocious passions, was greatly humanized by the refinement introduced by the rules and art of fencing. Skill with the sword is practically of advantage to those upon whom falls the duty of the national defense, to enable them to use loyally the weapon they alone are required to wear. But as the sword is no longer generally worn, and is not, among English-speaking peoples, used in dueling, adroitness in its use may no longer be feared as likely to create a fondness for contention; and fencing may be and is now resorted to as an enjoyable and healthful recreation and as a certain means of physical development. As an exercise it is void of danger, gives no occasion for rudeness, calls for no over-exertion, yet brings into active and graceful play every muscle of the body, and demands the eager and unremitting attention of every faculty.

A distinguished French authority on the art of fencing declares that a swordsman, on crossing blades with an antagonist and before closing in combat, must take in at a glance the intellectual and physical powers of his adversary, so as to judge of the employment he will likely make of them, and decide by the first few movements of his weapon if he is a man of nerve or one that may be intimidated or confused; observe on the instant if his guard is faulty, and what advantage may be taken of it; discover by feints his natural parry, and by his attitude and aspect whether his *forte* is the attack or defense; if he will probably rush in, trusting all to strength and audacity; and if he is one of whose attack signal advantage may be taken if anticipated, or who will contend warily with the skill of one accustomed to fencing, and must therefore be attacked with caution. This, so true in mortal combat, must be borne in mind by fencers to secure the best advantages from the use of foils as an exercise.

The Foil.—The foil or small-sword consists of two parts, the hilt and blade; and the hilt of three pieces, the pommel, the gripe, and the guard. The part of the blade nearest the guard is the fort. The two-thirds nearest the point are the feeble. The side of the gripe on which the thumb rests should be broad, flat, and convex, the opposite side slightly concave.

To hold the foil or sword in the most advantageous manner, the thumb must be extended along the convex side of the handle, and at least half an inch from the guard. The forefinger is partially extended on the under side, the middle portion opposite the thumb. The remaining fingers embrace lightly the side of the handle. At the moment of making a blow or parry the handle is firmly grasped, but to hold it so constantly would soon fatigue and paralyze the hand.

The *guard* is the attitude a swordsman assumes, best calculated for attack and defense. It is the position men take naturally when they meet in combat. The right foot is twice its length in front of the left, the knees bent equally, the right being vertically over the instep. The body should be erect, and its weight resting a little more on the left than the right leg. The right foot should point directly to the front, and the knees be flared apart. The weapon is at the same time raised to the height of the waist and turned near the left side, bringing the point to the front; the right arm is extended till it is half bent, the elbow about 6 inches in front of the side and turned in toward the body, the hand at the height of and opposite the right nipple, the nails turned up, the thumb horizontal, the back to the right. The point of the blade should be at the height and in front of the eyes. The left hand is extended to the rear and a few inches higher than the head, the elbow is slightly bent, the hand open, palm to the front. The arm from the shoulder to the end of the fingers forms a curve. The reverse of this position is true for left-handed men. The guard here described is the "middle guard," because in it the weapon occupies a middle position in reference to those it assumes in the defense. When on guard it is essential to be *covered* on the side toward which the adversary's blade points.

If the hand is carried to the right till it is so nearly in front of the right shoulder that the adversary's point, if extended on that side, would not touch, one is covered and the guard of tierce is formed; if to the left till the hand is sufficiently in front of the left breast to divert the point on that side, the guard of quarte is formed. The moment blades are crossed one or the other of these guards is formed, and is called the *engagement.*

Men of small stature should form the guard with the hand nearly as high as the neck; those of medium size, with the hand as high as the breast; tall men, with the hand a little below the breast. Although the guard should be habitually taken according to stature, still it must be varied, for it is dangerous not to make the height of the guard correspond with that of one's adversary.

The *engagement* is the act of crossing weapons and bringing them into contact. When the right of the blades is in contact, the engagement is in tierce; if the left, the engagement is in quarte. When the hand is turned so as to bring the back up and obliquely to the left, and the points lowered and brought in contact on the right, and at the height of the groin, the engagement is in seconde.

These are the only three engagements, and from these all blows are made; the last is rarely offered, unless from a feeling of superiority and to provoke an attack.

The *opposition* is a slight movement of the sword to bear the point of the antagonist's weapon out of the line of the person while delivering a blow to prevent falling upon it, and to avoid receiving a blow in return when in the act of recovering the position of guard. It must be insisted upon from the first blow a beginner makes till it becomes a confirmed habit.

To *change the engagement*, make a very small quick movement of the point, passing it under and as near as possible to the blade of the antagonist to the opposite side; this movement must be abrupt, and executed with the fingers only, without lowering the hand. *Cover* at the instant the point of the opposing blade is felt.

Feeling the blade consists in supporting and keeping the weapon in contact with the adversary's, without pressing upon it. This requires a delicate sensibility of the hand most essential to acquire. It indicates, in connection with the eye, when the opponent's blade has commenced an attack, and enables the weapon to be so managed in the parries as to deflect a blow without violence.

Fingering the sword is to conduct the point of the sword by the action of the fingers alone, without the aid of the wrist. To do this, the grasp, particularly of the two middle fingers, must be alternately relaxed and tightened. It is only by cultivating this that disengagements can be abruptly and closely made, and the point moved with quickness, dexterity, and precision either in making a feint or avoiding the adversary's disengagement in order to deliver a blow.

The *blow* is the act of directing the point toward the antagonist. It may be delivered in two ways—by means of the *thrust*, or with the thrust combined with the extension of the body called the *development*.

To *thrust*, extend the arm to the front fully and vigorously, raising the hand to the height of the mouth, and lower the point slightly by bending the wrist, but without loosening the grasp. At the same time throw the weight of the body forward on the right leg by straightening quickly and stiffly the left, and bring down the left arm by the side, rigidly extended, the hand about 3 inches above the left leg, fingers extended and joined, the palm to the left.

The *elevation* is raising the sword-hand when delivering the blow. This movement of the hand increases the probabilities of making a successful blow, while it acts as an important protection from a return blow.

The *development* is executed by, in addition to the action prescribed for the *thrust*, advancing the right foot close to the ground about twice its length, the left foot remaining firm in its position; the body is slightly thrown forward in an easy attitude, the head erect; the right knee vertical over the instep.

To *recover the guard*, raise the toe of the right foot, and exert strongly the muscles of the right leg, throwing up rapidly the left arm to the rear at the same moment, and take the position of guard. The right hand should be brought instantly to its position, never falling *below* it.

The left arm is an important auxiliary in all these movements in maintaining the equilibrium, and in materially assisting in the development and recovery of the guard.

To *advance*, move the right foot quickly forward its own length, raising it but slightly from the ground, and follow it at once with the left, moving it the same distance, and resume the position of guard. In advancing to make a blow at an antagonist who is out of distance, it is necessary to bring up the left foot near the right, keeping the legs well bent.

To *retreat*, move the left foot its length to the rear, and follow it quickly with the right, moving it the same distance, and resume the position of guard. The hand and point must neither rise nor fall in these movements. The point must remain steadily presented in a menacing attitude at the adversary.

Points of Attack.—There are three general points where an antagonist may be attacked when on guard. As the breast is nearest and most vulnerable, it is to be aimed at whenever exposed. But the point can not, in a desperate encounter, be directed with absolute certainty, and can not but be damaging wherever it touches. The blow at the face and right side, on the right of the weapon, is the attack on the "right"; at the face and left side, on the left of the weapon, the attack on the "left"; and under the sword-arm, the attack "below." Two of these points are always exposed, as the weapon can guard but one at any one moment.

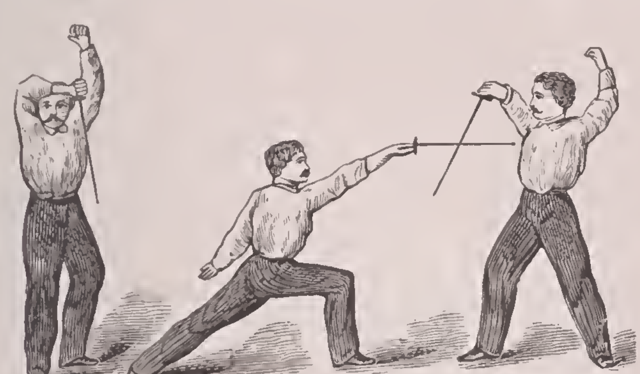
The *direct blow* is the result of the effort which carries the point to the front, in the most direct line, to the point of attack. It is the quickest of all the blows, and of course should be executed whenever the opportunity offers—that is, whenever the antagonist is *uncovered*. For instance, if engaged in tierce, to deliver a direct blow the point would be moved to the front on the same side (the right) as the engagement, should the antagonist momentarily uncover himself.

To *disengage* is to change the direction of the point and deliver a blow at the antagonist where he is not protected by his weapon; the movement of the point must precede the development. But these acts must be as nearly simultaneous as possible.

The *measure* is the distance the point attains when the person is fully developed.

The *appel* is striking the right foot on the ground, and generally twice in rapid succession, by raising it about an inch and striking it back with force. It is resorted to in making a feint to discompose the antagonist, or is done by the fencer to reassure himself in his position after a retreat, and deter his adversary from advancing too rapidly.

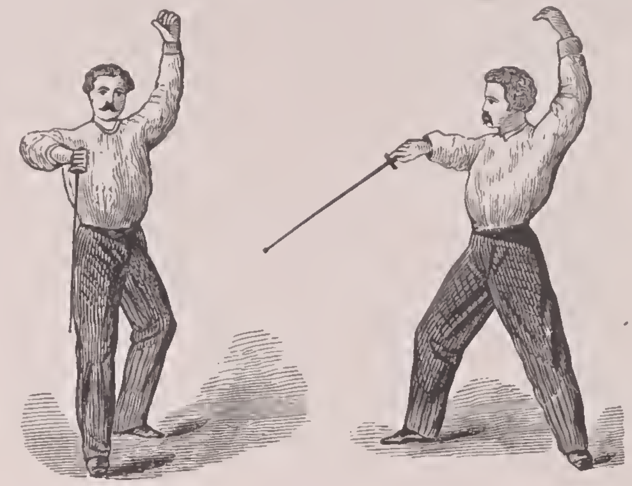
A *parry* is the action of turning aside the antagonist's blade from the point at which it is aimed. This is done with the fort of the blade. Ten parries have been decided upon as affording protection to the person from all blows that can be directed at it. They are designated by the (old) French ordinal numbers, and are thus known in all languages—viz., prime, seconde, tierce, quarte, quinte, six, sept, octave, counter-tierce, and counter-quarte. Tierce, quarte, quinte, and six are called simple parries, as the weapon is



Front view. Parry. Side view.

but slightly moved from the position of guard. Prime, seconde, sept, and octave are called half-counters, as the point describes a half circle in effecting the parry. The remaining two are called counters, as the point is made to describe a complete curve, returning to its original position. To parry correctly, the weapon must take a position which will protect the person, while at the same time the point is retained in front of the antagonist. The advantage of having a number of parries is to add to the security of the defense by embarrassing the antagonist in deciding which will be resorted to.

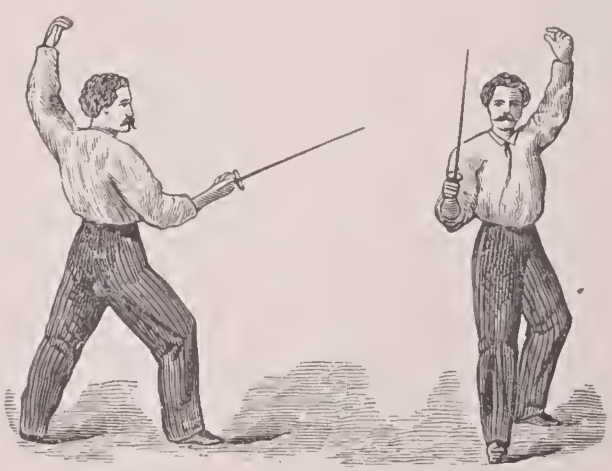
Prime is the position that would be involuntarily taken by one if attacked when in the act of drawing his blade from the scabbard. From the position of guard it is formed by turning the hand until the back is toward the left, keeping the point stationary to the front, then raising the hand



Front view. Prime. Side view.

diagonally to the left until the fore arm is in front of the forehead, describing with the point, in descending, a curve from right to left, arresting it on a line with the left side at the height of the waist. It is necessary to describe a curve with the point, so that the blade will cut the line of approach of the opposite weapon. Executed properly, it is most effective, as it may be used to turn aside every blow that can be made from the position of guard, which can not be said of any other parry. It is particularly advantageous to men of small stature.

Seconde naturally follows prime in case that parry is avoided. From guard it is formed by turning the hand in



Side view. Seconde. Front view.

pronation, both lowering it and moving it slightly to the right, describing with the point a curve, the convexity to the left, arresting the point on a line with the right side and at the height of the groin.

Tierce.—When seconde has been avoided by the antagonist's point, tierce would be resorted to involuntarily; it is

Front view. Tierce. Side view.

nearly the same as the guard of tierce. From the middle guard it is formed by moving the hand to the right till it is opposite the right side, keeping it in supination—that is, with the back down; the point moves as little as possible, the hand is drawn slightly back.

Quarte would naturally follow to parry a high disengagement from tierce. It is formed from the middle guard by

Front view. Quarte. Side view.

moving the hand to the left as far as the left side, inclining the nails slightly to the left. The point is maintained in its position as nearly as possible.

Quinte.—Quinte is naturally resorted to in order to parry a low disengagement from tierce. It is formed by lowering the hand diagonally, placing it in front of the left side at

Front view. Quinte. Side view.

the height of the groin, the nails to the left; the point is arrested as nearly as possible on a line with the right shoulder of the antagonist.

Six was formerly tierce parry, and constituted among early masters the guard of tierce; it is yet too frequently confounded with the true tierce. It is formed from middle

Front view. Six. Side view.

guard by turning the hand in pronation and moving it opposite the right side; the point is in front of the antagonist and at the height of the crown of the head.

Sept.—This parry is also called demi-circle. It is formed from middle guard by bending the wrist and lowering the point, describing with it a slight curve, the convexity to the right; the hand is raised slightly and moved to the left, opposite the left side, and the point is arrested in front of the groin of the antagonist. Sept is used to parry blows delivered at the waist, but is less effective than quinte.

Side view. Sept. Front view.

Octave.—This parry is formed from guard by bending the wrist, retaining the arm in its position, and lowering the point, describing with it a slight curve, the convexity to the left; the hand is moved in front of the right side, and the point is arrested opposite the groin of the antagonist.

Counter-parries are those in which the point moves under and around the antagonist's weapon, returning to the position from which it started. In executing a counter the arm should not move, the wrist alone acts. The point in its motion describes an ellipse. Every parry may have a corresponding counter; but two, however, are found to be of advantage—counter-tierce and counter-quarte. The counters have two advantages: they cut all the lines of attack, and throw off the weapon of the antagonist to the side on which he is prepared to take the opposition, and consequently may leave him uncovered and exposed to a direct return blow.

Counter-tierce.—Being engaged in tierce, when the antagonist disengages at the "left" lower the point with a quick bend of the wrist, passing it under the approaching weapon, and throw it off to the right.

Counter-quarte is executed after the same manner from the engagement of quarte; the blow is thrown off to the left. The point in both these parries must be arrested opposite the antagonist's face.

Double Counters.—The execution of the counters twice in quick succession is called a *double counter*. It is a parry that should be much practiced, as it gives great command of the weapon.

Disengagements.—The disengagement from tierce to quarte, or from quarte to tierce, is made by pressing on the gripe with the thumb and middle fingers, changing the point from one side to the other with an abrupt and rapid motion, at the same time that it is moved in a spiral direction to the front. The point should be directed at the right nipple. The curve which the point makes around the blade should be as small as possible. To disengage "below" from tierce or quarte, the point is lowered by bending the wrist, and moved to the front at the same time just under the blade of the antagonist. The disengagement from tierce at the "left" may be parried with quarte, a simple parry, prime, seconde, and octave, half counter, and with counter-tierce. The disengagement from quarte at the "right" may be parried with tierce and six, with prime and sept, and with counter-quarte. The disengagement "below" from tierce may be parried with quinte, prime and with seconde and octave; from quarte, with prime and sept.

Feints.—A feint is a quick movement of the point toward an exposed "point of attack," as if a blow was intended, the object being to disquiet the antagonist and induce him to move his blade, and thus expose himself. To execute a feint, the point must be moved smoothly and quickly to the front, nearly to the full extent of the arm, and as close as possible to the antagonist's weapon. The hand should be raised to the height of the mouth; neither the body nor the legs should move. The feint may be accompanied with an appel. In feinting "below," lower the point in a vertical line, and move it to the front just under the antagonist's guard, being careful to raise the hand well. To execute a feint at the "left," supposing the engagement to be in tierce, change the point and advance it nearly to the full length of the arm, describing with it the smallest possible circle around the antagonist's weapon. A feint is followed by a disengagement or by a direct blow. If the opponent moves his weapon to oppose the feint, disengage; if he does not move it, deliver a direct blow, being careful to take in either case the opposition.

Counter-disengagements.—To avoid the counter-tierce and counter-quarte parries, it is necessary to move the point entirely around the adverse blade, describing a very small circle near the shoulder of the foil. This, if followed by delivering a blow, is called a counter-disengagement.

The *riposte* is the blow that immediately follows a successful parry. It may be delivered with the thrust or development, direct or with a disengagement. If delivered direct, it should be with such rapidity as to touch the opponent before he recovers his guard. It may be made also by first menacing a direct thrust, and as soon as the opponent recovers his guard and covers the point of attack menaced, then disengaging.

To *menace* is to advance the point quickly by a partial extension of the arm on the side of the engagement, as if about to make a direct blow. In menacing after a parry the opposition must be maintained. If the adversary moves his blade toward the point menaced, disengage; if he does not, deliver a direct blow.

Ripostes are usually attempted after quarte, quinte, six, and tierce, counter-quarte, and counter-tierce parries. The riposte, after six, from the favorable position of the hand, can be delivered with more certainty and fatal effect and with more rapidity than any other. These ripostes are all executed by the thrust or development, raising the hand and lowering the point, directing it at the face and neck, or by first menacing and then disengaging at whichever point of attack may be uncovered.

Riposte after Prime Parry.—Keep the hand in the position of prime, and by a rapid extension of the arm, and making a strong effort with the thumb and wrist, direct the point "below."

To Riposte after Seconde Parry.—Lower the hand, keeping it in pronation; raise the point and deliver the blow at the flank, or menace "below" and turn the hand as in tierce, and deliver the blow at the "right."

To Riposte after Six.—Raise the hand as high as the head, turning the thumb directly down; lower the point over the guard of your antagonist, and deliver the blow at the "right," or disengage "below."

To Riposte after Sept Parry.—Lower the hand and deliver the blow at the flank; or menace, and as the antagonist covers himself and recovers his guard, disengage.

To Riposte after Octave Parry.—Lower the hand very slightly, raise the point, and deliver the blow at the flank. This is also called *flanconade.*

Disengagements by cutting over the point are made by raising the blade over the point of the antagonist's weapon and as close as possible to it. The cut, as a simple blow, is always preceded by a feint, or an attack upon the weapon, by exerting some force upon it, pressing or striking it aside. For instance, whether on guard in quarte or tierce, turn the hand, the thumb up, and with a sudden energetic pressure move the antagonist's point out of the line of the body; then leave his blade abruptly and extend the point to the front; as soon as the antagonist covers, raise the blade over his point and develop. The cut is most successfully made at the "right," first compelling the antagonist to parry quarte.

Ruse.—Force in fencing accomplishes little, quickness much, but ability and skill to deceive the antagonist everything.

On Commencing the Attack.—The disengagement, simple feint, and menace have been explained. The other modes of commencing an attack are as follows:

Gliding the weapon is executed by moving it smoothly along, and in slight contact with the adversary's, till the arm is nearly extended, then terminating the movement with the greatest celerity, executing a direct blow. The opportunity for making this blow can only occur when the opponent is not covered, and, as the point approaches him, does not take the opposition. If the opponent protects himself, taking the opposition, a disengagement may be made.

Pressing.—Without quitting the adversary's blade, move the weapon forward quickly, bearing upon his, commencing at the feeble, and develop, or if the opposition is taken, disengage. This blow is employed with advantage against one who extends the blade too much.

Beating.—Raise the point slightly and strike the opponent's weapon at an acute angle, the fort against his "feeble." It is employed against an extended guard to displace the point of an adversary upon whom a feint has no effect, in order to afford an opportunity for a disengagement.

False beating or *tapping* is to strike the adversary's weapon with the "feeble" on the side of the engagement a slight quick tap, by the action of the wrist alone, for the purpose of disquieting him, and causing him to grasp nervously his weapon and make some movement of which advantage may be taken. It is often done several times in rapid succession. The same effect may be produced by rapidly changing the guard.

Removing the Point.—When an adversary has a hard hand and bears upon the weapon, remove the point suddenly, but only a short distance. Finding the support to his blade removed, he will involuntarily seek it, and will almost certainly afford an opportunity for making a direct blow or disengagement; or he may attack, of which, being anticipated, advantage may be taken.

Crossing is employed against an antagonist who, without replying to a feint, extends his blade, presenting it at the breast. It is executed by holding the hand high and turning the blade over that of the adversary, and forming the parry of seconde or sept (demi-circle), thus securing command of his weapon and an opportunity of attacking "below." Crossing, if done with force and skill, will disarm. To disarm, however, in fencing as an exercise, is a discourtesy.

Binding is employed the instant after a successful parry, when the feeble of the adversary's blade is controlled. For instance, if the antagonist disengages from quarte "below," and the blow is parried with sept, then an opportunity occurs to bind his weapon by turning the blade under his, and with a quick motion of the wrist raise it and throw it off to the right. If done at the nick of time, as the antagonist is recovering his guard, an opportunity is given to deliver a blow at the "right," where he will be uncovered, his weapon still retaining its opposition in quarte with which he delivered his blow. Binding after the parry, if octave, may be effected after the same manner. The weapon in this case is thrown off to the left, and a blow may be delivered at the "left." In either case, if the antagonist is quick enough after his weapon has been bound to close the line of the direct blow, a disengagement should follow.

Flanconade.—The blow delivered at the flank of the antagonist when he menaces at the "left" is called flanconade, and is executed as follows: If engaged in quarte, the antagonist menaces or extends his point too far to the front and low, or if he feints at the "left" from the engagement of tierce, execute the parry of octave and deliver a blow at the flank, raising well the hand. This blow is parried with octave or seconde.

Time thrusts are made at an antagonist who, in delivering his blow, is uncovered or who makes a too wide disengagement. Such blows may be best parried by attacking in return, by a quick extension of the arm, taking a strong opposition.

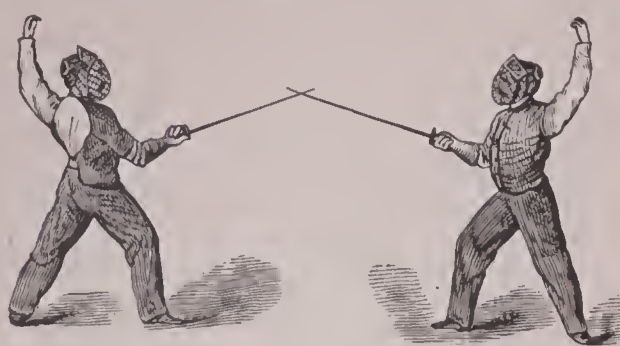
Time blows are those delivered at an antagonist who advances within distance uncovered, or who makes his feints too slow or wide. As the success of such blows depends upon the readiness with which advantage is taken of the momentary indiscretion of an antagonist, they are regarded as the most brilliant in fencing.

Encircling is effected by raising the hand after parrying six, mastering with the fort the feeble of the adversary's blade, then (as the latter rises and tries to guard against the riposte) turning or sliding the blade around it without quitting it, and riposting "below" or by a cut over the point at the "left."

Combinations.—A feint followed by a disengagement is called "feint *one, two.*" For instance, if engaged in tierce, feint one, two would be made by showing the point at the "left," and when the opponent covers the "left," disengaging at the "right." If, instead of this disengagement, a feint be made at the "right," and when the opponent covers the blow be delivered "below" or at the "left," the combination would be feint *one, two, three.* Two feints and a disengagement or counter-disengagement, or cut over the point, or a feint and a double counter-disengagement, is as much of a combination as can be attempted in an assault.

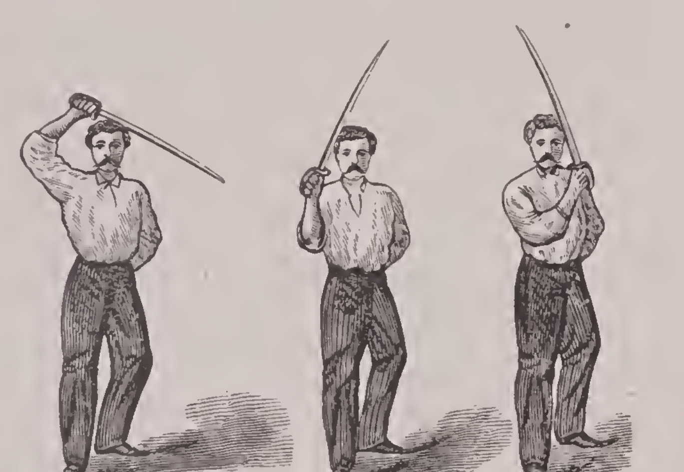
Wall practice, or tierce and quarte, is an exercise for the purpose of acquiring a fine development and great precision in making the simple disengagement at the "right" and "left."

The *salute* is a preparatory exercise in the fencing-hall in which fencers indulge as a compliment to spectators and



The assault.

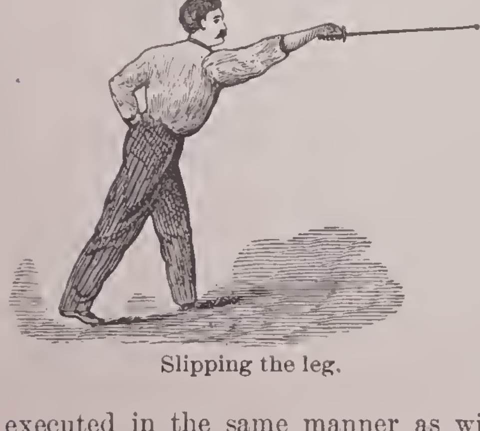
to each other, and to assure themselves before engaging in an assault. The masks are laid aside. The fencers, on first taking the position of guard, rise, salute with their weapons each other and the spectators on the right and left. On resuming guard in tierce, one disengages first at the "left," then at the "right," the blows being delivered with a loose hand, so that the weapon, on being parried, will be turned and the point thrown to the rear, the parrier at the same time lowering his point out of line. After a few repetitions of these disengagements the first fencer will discontinue, and will so indicate by an appel, both rising. The guard of tierce is then again resumed, and the other fencer will make the same disengagements. On appelling and both rising, the salute with the weapon will terminate the exercise, when masks will be resumed and the assault commenced.



Prime against cut. Tierce against cut. Quarte against cut.

The Saber.—The attack and defense with the foil are the bases for those of the saber.

The guards with the saber are essentially the same as with the foil—in tierce, quarte, and seconde; the left hand, however, is placed on the hip, to avoid cutting the arm. The edges of the sabers are in contact. The ordinary guard is tierce. The points of attack are the same—at the "right," "left," and "below." Blows, both points and cuts, are delivered with the thrust and development, direct or by disengagement. The attack is begun by feints or by attacks upon the weapon. In delivering the point at the "right" from the engagement of tierce, the saber is turned, the edge up, the back of the hand to the left. The parries are prime, seconde, tierce, quarte, and demi-circle, and against points are executed in the same manner as with the foil. Against cuts at the head, the hand, in parrying prime, tierce, and quarte, is raised, so that the saber affords the required protection. Cuts are made with the point of the saber and by a motion of the wrist alone, raising the saber as little as possible. With a keen edge slight force will inflict a fatal cut. From the ordinary engagement of tierce the first cut would



Slipping the leg.

be made at the face or right of the head, and parried with tierce. Or the cut may be at the left of the head by raising the hand, turning the edge of the saber to the left as it is launched beyond the antagonist, making the cut in drawing the hand back. The parry against this cut is prime. The cut "below" at the right flank would be parried by seconde. From the engagement of quarte the first cut would be at the face or left of the head, and parried by quarte, or at the right of the head, by raising the hand, turning the edge to the right as it is launched beyond the antagonist, making the cut in drawing the hand back.

Riposte with point after tierce parry.

The cut "below" at the left flank would be parried by demi-circle. The cut at the leg is best avoided by withdrawing the leg, at the same time extending the point.

Cut after prime parry.

The most effective parries are prime and seconde. The most effective ripostes are with the point after tierce parry, with the cut after prime. J. C. Kelton.

Fen Country: See the Appendix.

Fendall, Josias: Governor of Maryland from 1656 to 1660; appointed by Parliament in 1658, his previous appointment, in 1656, having been made by the proprietors; superseded in 1660 for intrigue, and subsequently banished; in 1681 a fine of 40,000 lb. of tobacco was imposed upon him.

Fénelon, fā'ne-lōn', François de Salignac de la Mothe: archbishop and author; b. at the château de Fénelon, Périgord, France, Aug. 6, 1651; went to the University of Cahors in 1663, and thence to the College of Plessis. He preached his first sermon in 1666, went thence to the Seminary of Sulpice, and received holy orders about 1675. In 1678 was superior of the order of Nouvelles Catholiques, for the instruction of new converts. In 1686, after the Revocation of the Edict of Nantes, he was sent by Louis XIV. to Poitou to convert Protestants. He was preceptor to the Duke of Burgundy in 1689, tutor to the Duke of Anjou in 1690, and to the Duke of Berri in 1693. In the same year he became a member of the French Academy. Was appointed Archbishop of Cambray Feb., 1695, and during that year, as afterward, became the friend and defender of Madame Guyon. Bossuet denounced him as a heretic in 1697, and in 1699, Fénelon, having in vain appealed to the pope, signed his renunciation of Mme. Guyon's doctrines, and died at Cambray, Jan. 7, 1715. Among Fénelon's earliest works was *Traité du Ministère des Pasteurs*, an argument against Protestantism. While tutor to the Duke of Burgundy he wrote *Dialogues of the Dead*, etc. His *Explication des Maximes des Saints*, regarded as an indirect apology for Guyonism, appeared in 1697, *Les Aventures de Télémaque* in 1699. Other works of Fénelon's were *Dialogues on the Eloquence of the Pulpit*, *Demonstration of the Existence of God*, *On the Temporal Power of the Mediæval Popes*, a *Treatise on the Education of Girls*, etc. The following works may be consulted: Ramsay, *Vie de Fénelon* (Paris, 1725); Cardinal de Bausset, *Histoire de Fénelon* (4 vols., 1808); Gosselin, *Histoire littéraire de Fénelon* (1843); Charles Butler, *Life of Fénelon* (London, 1810); Alphonse de Lamartine, *Fénelon* (Paris, 1854); Henri Lemaire, *Vie de Fénelon* (1826); J. F. de Laharpe, *Éloge de F. de Salignac de la Mothe Fénelon* (1771); Maury, *Éloge de Fénelon* (1771); Roy, *Histoire de Fénelon* (1842); Werfer, *Leben des F. Fénelon*, etc. (1852); E. Gandar, *Fénelon et son Temps* (1864); H. L. Lear, *Fénelon, Archbishop of Cambrai* (London, 1876; 3d ed. 1884). Revised by J. J. KEANE.

Fen′elon Falls: village; Victoria co., Ontario, Canada; between Cameron and Sturgeon lakes; 16 miles N. of Lindsay, with which it is connected by steamboat (see map of Ontario, ref. 3–E). It has large lumber-mills, and a waterfall 20 feet high and 300 feet wide. Pop. about 1,200.

Fenestel′la: a genus of fossil bryozoans, of which many species have been obtained from the Palæozoic rocks. They usually have the form of a calcareous network, of which the meshes are often quadrangular, resembling little windows, whence the name. The threads of the network are poriferous. The corallum of *Fenestella* frequently grows in the form of a broad, ribbon-like frond, spirally wound round and radiating from a central axis. J. S. NEWBERRY.

Fenestella: a Latin historian who flourished under Augustus, and continued to live into the reign of Tiberius, since, according to the statement of Jerome, he died in the seventieth year of his age, A. D. 19. Nothing further is known positively of his life. He wrote a work entitled *Annales*, of which the twenty-second book is cited by Nonius, and which supplied to Plutarch materials for some of the statements in his *Lives* of distinguished Romans. It probably extended from the period of the kings down to and including the later history of the republic, which portion seems to have been more fully treated than the earlier. See J. Pöth, *De Fenestella hist. script. et carm.* (Bonn, 1849). The fragments are collected in H. Peter's *Hist. Rom. Fragmenta* (Leipzig, 1883), pp. 272–278.

Fêng-shui: same as FŬNG-SHUI (*q. v.*).

Fe′nian: a name first applied in the early history of Scotland and Ireland to a tribe of warriors noted for their prowess. Finn MacCumhail was their most famous chief. According to Irish annals he died about 285 A. D. So great was his renown that these Gaelic warriors were henceforth called Feinne, Fiana, or Fenians. Their deeds form the theme of many poems and legendary tales in Celtic literature, and are also commemorated by various names in Scotch and Irish topography. In early Irish histories they are represented as an established militia, whose duty it was "to defend the country against foreign or domestic enemies, to support the right and succession of their kings, and to be ready, upon the shortest notice, for any surprise or emergency of state." With the rise of monasticism the ancient order disappeared, but Finn and his Fenians, and especially his two sons, Fergus and Oisin (the Scottish Ossian), long remained to the Gaelic imagination what Arthur and his knights were to the Cymric.

In 1859 the name was applied to an organization of Irishmen that was formed in the U. S. and Great Britain to secure the independence of Ireland. The organization was constituted on republican principles, having its social, district, and State circles, and its congress, in which was vested the supreme legislative authority and the choice of the chief executive officer. The first Fenian congress met in Chicago in 1863; the order, however, did not attract much attention until its second congress, in Cincinnati in 1865. It then became very popular among the Irish, 80,000, it was said, belonging to it in the U. S. In 1866 several attempts were made by the Fenians in the U. S. to invade the British provinces, but all, except two, were frustrated by the U. S. authorities. The two companies of Fenians who succeeded in crossing the Canadian frontier were speedily driven back, and most of those who returned were taken prisoners by the authorities and sent on parole to their homes. During the following year there was a number of Fenian riots in Great Britain, but all were soon quelled, and some of the rioters hanged. From that period the Fenian excitement rapidly subsided. Divisions occurred in the organization, the masses lost confidence in their leaders, and many of the wrongs of Ireland which they sought to redress were abolished by legislation.

Fénin, fā′năn′, PIERRE: a nobleman from Artois; served at the court of Charles VI., and became prefect of Arras, where he died June 5, 1433. He was for a long time considered the author of the so-called *Chronique de Fénin*, but Mlle. Dupont, the last and most competent editor of that book, ascribes it to his son. The book, as it now exists, seems to be a compilation lacking both the beginning and the end. The existing fragment consists of two parts, differing considerably both in style and method of composition, the first part comprising the period from 1407 to 1422—that is, the close of the reign of Charles VI.—and the second the first five years of the reign of Charles VII.

Fennec [from Arab. *fanek*]: a small fox (*Vulpes* or *Fennecus zerda*), distinguished by the size of its ears, inhabiting Northern Africa. The body is about a foot long, the bushy tail a little less; the ears are 3 inches in length. The general color is yellowish, except the tip of the tail, which is black. The fennec lives in burrows, and is partly nocturnal in its habits. The name fennec is sometimes erroneously applied to a small South African fox, *Megalotis lalandii*.

F. A. LUCAS.

Fennel [from O. Fr. *fenoil* > Mod. Fr. *fenouil* < Lat. *feni′culum*, deriv. of Lat. *fe′num*, hay]: the popular name of a genus (*Fœniculum*) of Old World umbelliferous herbs, closely allied, and by many assigned, to *Anethum*, the dill genus. The *Fœniculum vulgare* (common fennel), *Fœniculum dulce* (sweet fennel), and *Fœniculum officinale* of Europe (the first cultivated in the U. S. also) are raised extensively for their seeds, a very pleasant, warm, aromatic much employed in pharmacy. These seeds abound in volatile oil of fennel. The leaves and blanched shoots are used as salad and potherbs in Europe. The *Fœniculum capense* of South Africa has an edible root. The *Fœniculum panmorium* of India is much cultivated for its aromatic seeds. Among the popular superstitions there is a belief that he who sows fennel-seed sows sorrow. Fennel-leaves were once emblematic of grief. The giant fennel, in whose stalk Prometheus concealed the fire which he stole from heaven, was the *Ferula ferulago* of the Mediterranean coasts, whose pith is still used as a port-fire and as tinder. This coarse plant is also umbelliferous. "Small fennel" is the *Nigella sativa* of Europe and Asia, the "love-in-a-mist" of gardens, a small ranunculaceous herb with quaint flowers and aromatic seeds, sometimes used in cookery and medicine.

Fenton: village; Genesee co., Mich. (for location of county, see map of Michigan, ref. 7–J); on the D., G. H. and M. Railroad; 50 miles N. W. of Detroit. It has a union school, a large normal school, two gold-cure institutes, an extensive flouring-mill, a cooperage, an iron-foundry, an extensive window and door-screen factory, manufactures of drills, pumps for water-works, whip-sockets, novelties, etc., electric lights, and a fine system of water-works. Pop. (1880) 2,152; (1890) 2,182; (1900) 2,408.

EDITOR OF "INDEPENDENT."

Fenton, ELIJAH: poet; b. in Staffordshire, England, in 1683; had M. A. from Cambridge University in 1704. He assisted Pope in the translation of the *Odyssey*. His *Mariamne* (1723), tragedy, was successful. He wrote also *Life of Milton* (1727) and other works. D. in Berkshire, July, 1730.

Fenton, REUBEN EATON: statesman; b. at Carroll, Chautauqua co., N. Y., July 4, 1819; educated at Pleasant Hill and Fredonia academies; studied law, and settled at Jamestown, N. Y.; after practicing a few years became a merchant. He was supervisor of Carroll in 1843, Representative in the U. S. Congress from the Thirty-third District of New York from Dec., 1857, to Mar., 1865, Governor of New York from 1865 to 1869, and U. S. Senator from New York 1869–75; chairman of the U. S. commission at the international monetary conference in Paris in 1878. D. at Jamestown, N. Y., Aug. 25, 1885.

Fen Town: See LONDON.

Fen′ugreek [cf. Fr. *fenu-grec* < Lat. *fenum græcum*, Greek hay]: a name given to the *Trigonella fœnum-græcum* and other species of the genus, leguminous annual herbs of Asia and Europe, resembling clover. The above species is cultivated in France and Germany for its seeds, which are ground into an oily, mucilaginous meal, much used in farriery as a vehicle for drugs. They were once valued in medicine, but are now only employed in poultices, etc. Another species, growing spontaneously in India, is much used as fodder for cattle.

Fenwick, Sir JOHN: English Roman Catholic conspirator in the reign of William III.; b. near the middle of the seventeenth century; was committed to the Tower for his part in the assassination plot June 11, 1696, and a bill of attainder against him being passed on Jan. 11, 1697, he was executed on Jan. 28 in the same year. This was the last execution in consequence of attainder in Great Britain.

Fenwick, JOHN: Quaker and founder of a colony in New Jersey; b. in England in 1618. His grant of land in West Jersey was obtained in 1673, and he settled at Salem in 1675. In 1678 Gov. Andros, disputing his claim to the governorship, confined him in prison two years. Fenwick transferred his claim to William Penn, and died in poverty in 1683.

Fenwick, JOHN R.: soldier; b. at Charleston, S. C., 1780; educated in England, and entered the service of the U. S. as lieutenant of marines Nov., 1799; promoted to be captain in that corps 1809. In Dec., 1811, he accepted the commission in the army of lieutenant-colonel of artillery; as such served with distinction in the war with Great Britain 1812–15, particularly at the assault on Queenstown Heights, Oct. 13, 1812, where he was three times wounded and made prisoner. Breveted colonel Mar. 18, 1813, for gallant conduct on the Niagara frontier, was on same date appointed adjutant-general of the army, with the rank of colonel, and disbanded as such June 1, 1815, but retained in the army as lieutenant-colonel of light artillery; commissioned colonel Fourth Artillery May 8, 1822; brevet brigadier-general Mar. 18, 1823. D. at Marseilles, France, Mar. 19, 1842.

Feodosia: See KAFFA.

Feoffment [from O. Fr. *feoffement*, deriv. of *fieffer*, to invest with a fee, deriv. of *feu*, from O. H. Germ. *fehu*, property, cattle: O. Eng. *feoh* > Eng. *fee*; cf. Lat. *pecu*]: a mode of conveyance of landed property, formerly in use in the English law, by which land or other corporeal hereditaments were transferred by one person called a *feoffor* to another called a *feoffee*. Feoffment meant originally, under the feudal system, the giving of a feud or fee (see FEE), but in the modification of the system of land tenure which afterward ensued it was employed to denote the grant of an estate in fee-simple, and was then extended to any transfer of freehold estates in hereditaments purely corporeal. An actual delivery of the land was made by a peculiar ceremony known as *livery of seizin*—i. e. a delivery of the possession of the land by taking the feoffee upon or near it and directly investing him with the ownership and occupation. When the parties entered upon the land the livery was said to be *in deed*, and in the presence of witnesses the feoffor handed to the feoffee a clod or turf or a twig or bough as a symbol of actual investiture, at the same time uttering certain words of transfer. When the delivery was made in sight only of the land, the livery was said to be *in law*; and in order to make the transfer effectual the feoffee had to make an actual entry during the feoffor's life. The words of donation which accompanied the livery were at first oral, but at an early period they were reduced to writing in the form of a deed of transfer, though no written instrument was imperatively required until the enactment of the STATUTE OF FRAUDS (*q. v.*). Conveyance by feoffment was for a long period in English history the only ordinary method of transfer of land in possession. It has been entirely superseded by more convenient methods. It was only to be tolerated at a time when the means of communication between different sections of country were imperfect, and transfers of property were generally made between residents in the same immediate neighborhood. As a part of the common law it was in use in the U. S. until abolished. It was frequently resorted to as a means of "disseising" a claimant of land, and thus setting in motion the statute of limitations. In this way, after the lapse of a certain number of years (say twenty-one), a party would gain a title by force of his uninterrupted possession and claim of ownership. For an instance of this, see *McGregor* vs. *Comstock*, 17 New York Reports, 162. The mode of conveyance now in use is by deed. See DEED. GEORGE CHASE.

Fe'ræ Natu'ræ [Lat., of a wild nature]: a legal term applied to such animals as are naturally of a wild disposition, as bears, foxes, deer, pigeons, wild geese, etc. The separation of such animals as a class from those which are domestic is of importance in law, on account of the difference in the right of property which an owner is held to have in the two instances. Property in domestic animals is absolute, or indefeasible, while in animals *feræ naturæ* it is only qualified—i. e. the right of property continues to exist only as long as the animals are reclaimed from their savage or wild condition, and ceases when they return to it. When animals are of such a kind that if once restored to their freedom they would never return of themselves to their owner, his ownership of them can continue only so long as he keeps them confined. Wild beasts in a menagerie would be of this character. But if animals naturally wild have become so tamed that if suffered to escape or roam at large they have a habit or disposition of returning (*animum revertendi*), a qualified property in them continues so long as this habit is found to have a controlling influence. But if they stray and remain absent it is lawful for any stranger to take them as his own property. Pigeons, bees, deer are familiar examples of this kind of wild animals. A property in bees is obtained by hiving them. But if they swarm and fly away, the owner retains his property as long as he keeps them in sight while pursuing them, so that he may distinguish them as from his own hive. A qualified property may also exist in certain cases by reason of the inability of the animals to depart from a person's property, as in the case of the young of wild birds who have built their nest in trees. While a qualified property continues, the owner's right is as much under legal protection as is his interest in property of any kind, and any interference with it is punished in the same manner. The owner of such animals will in some instances be liable for their acts. A distinction is to be taken between animals that are and are not naturally inclined to do mischief. In cases of the first class the owner is not in general responsible for injuries done by his animals unless he is shown to have special knowledge of some vicious propensity. This knowledge is technically called *scienter*, and must be alleged in an action and proved. This proof would not be necessary if the animals were trespassing on the land of another. The owner in that case is liable for acts done in the course of the trespass. When the animal belongs to the second class, and is naturally inclined to do mischief, no proof of knowledge is requisite, as the owner is presumed to have knowledge of its vicious propensities.

In regard to the right in wild animals killed upon any person's property, certain peculiar rules have been established. If such animals, while upon or flying over a person's land, are killed either by himself or by a trespasser, they become the land-owner's property. If he starts animals upon his own grounds, follows them into another's, and there kills them, the property remains in himself. If a trespasser chases game from one man's land into another's, and there kills it, he has a claim superior to that of the owner of either of the contiguous estates. This last rule has, however, been questioned. A number of statutes in regard to the preservation of game and the protection of wild animals of various kinds have been passed both in Great Britain and in the U. S.

GEORGE CHASE.

Fer de Lance, fār'de-läañs' [Fr., liter., lance-iron, lance-head]: a venomous serpent (*Craspedocephalus lanceolatus*) of the West Indies. It is so named in allusion to the peculiar markings on its head. This much-dreaded serpent is extremely prolific, and is from 5 to 8 feet long. It gives no warning of its attack. The bite is very often fatal, and when its present effects are warded off by stimulants it usually ruins the health of the sufferer, who is for years afflicted with boils and ulcers, and often with paralysis and other distressing symptoms. It is dreaded by all animals, and the horse can not by the spur or the whip be forced to pass within striking distance of this formidable reptile.

Fer de lance.

Ferdinand the Just: King of Aragon; was co-regent of Castile and Leon near the close of Dec., 1406; became king in June, 1412, and in 1413 defeated and imprisoned the Count of Urgel. D. 1416.

Ferdinand I.: Emperor of Austria; eldest son of Francis I., Emperor of Germany; b. Apr. 19, 1793; married Maria Anna Carolina Pia, daughter of Victor Emmanuel I., King of Sardinia, in 1831. He took the throne Mar. 2, 1835, but was under the direction of Prince Metternich, his Prime

Minister. On Dec. 2, 1848, he abdicated in favor of Francis Joseph, after having repeatedly fled from Vienna during the revolutionary agitations of that year. D. at Prague, June 29, 1875.

Ferdinand I.: King of Bohemia and Hungary and Emperor of the Romans; b. at Alcalá, Spain, Mar. 10, 1503; married Anne Jagellon May 5, 1521, and was made King of Bohemia Feb. 24, 1527, of Hungary, Oct. 28, 1527, and of the Romans in Jan., 1531. He took the title of emperor when his brother, Charles V., abdicated, near the end of Sept., 1556, and was recognized as emperor by the electors at Frankfort in 1558, but was forbidden to take the title by Pope Paul IV. In 1562 he sent ambassadors to the Council of Trent. D. at Vienna, July 25, 1564.

Ferdinand II.: King of Bohemia and Hungary and Emperor of the Romans; b. July 9, 1578; crowned King of Bohemia July 29, 1617. He failed to protect his Protestant subjects against the persecutions of the Roman Catholics, and the Bohemian states deposed him Aug. 19, 1619, and offered the crown to Frederick, elector-palatine. This brought on the THIRTY YEARS' WAR (*q. v.*). Ferdinand had been crowned King of Hungary at Presburg July 1, 1618, and was elected Roman emperor Aug. 28, 1619. Frederick, having accepted the Bohemian crown, was defeated by Ferdinand's army, under Maximilian of Bavaria, at Prague, Nov. 8, 1620, and in 1623 the Bavarian duke received the Palatinate. In 1625 the imperial generals Wallenstein and Tilly defeated the armies of another Protestant league against Ferdinand, with the King of Denmark at its head. In Dec., 1625, and Nov., 1627, respectively, Ferdinand resigned the crowns of Hungary and Bohemia to his son, Ferdinand III. In 1630–32 Gustavus Adolphus of Sweden, with France and Venice in a new league against the emperor, invaded Germany, and gained important successes over Ferdinand, although at the battle of Lützen in Nov., 1632, the Swedish monarch was slain. The battle of Leipzig was fought in Sept., 1631, that of the Lech in Apr., 1632. Chancellor Oxenstiern directing the league after the death of Gustavus Adolphus, Ferdinand was more fortunate, made peace with some of the allies, and procured the election of his son Ferdinand as King of the Romans. D. at Vienna, Feb. 15, 1637.

Ferdinand III.: King of Bohemia and Hungary and Emperor of the Romans; b. in July, 1608, and became King of Hungary and Bohemia 1625 and 1627, respectively. In 1631 he married Mary Anne of Spain, who died in 1646. He gained the battle of Nördlingen in the contest of his father (Ferdinand II.) against the Swedes and their allies Sept. 6, 1634, and was made King of the Romans in 1636, and became emperor in 1637. The Thirty Years' war continuing, the battles of Thionville, of Fribourg, and of Sommershausen were fought in June, 1639, in 1644, and in 1648. In this latter year Ferdinand married Maria Leopoldina, who died in 1649. In 1648 he also signed the peace of Westphalia, guaranteeing religious liberty to his Protestant subjects. In 1651 he married Eleanor of Mantua. D. at Vienna, Apr. 2, 1657.

Ferdinand I. (THE GREAT): King of Castile and Leon; married Doña Sancha of Leon, and was named King of Castile in 1033, succeeding to the throne in 1035, and being crowned King of Leon June 22, 1038. He invaded Portugal, and acquired Coimbra in 1044 and 1045. In 1046–49 he warred against the Moors. In Sept., 1054, he defeated Garcia III., King of Navarre, near Burgos; in 1063 conquered Mohammed ben Abad, dividing his kingdom between his three sons in 1064. Forced the Kings of Saragossa and Toledo to become his tributaries in 1065, and died at Leon, Dec. 27 of that year.

Ferdinand III. (THE SAINT): King of Castile and Leon; b. 1199; son of Alfonso IX., King of Leon, and Berengaria, Queen of Castile, succeeding in Castile, on his mother's abdication, in 1217, and in Leon in 1230. In his Moorish wars he conquered the kingdom of Baeza, took Cordova and Seville, and made the Kings of Granada and Murcia his tributaries. D. May 31, 1252, and was canonized by Pope Clement X. in 1671.

Ferdinand V. (THE CATHOLIC): King of Castile and Aragon; b. at Sos, Spain, Mar. 10, 1452; married Isabella of Castile Oct. 18, 1469. At this time Spain was divided into the kingdoms of Castile, Aragon, Navarre, and Granada, the last held by the Moors. On the death of Isabella's brother, Henry IV., Ferdinand was proclaimed king, with her as queen, at Segovia, Dec. 13, 1474. Isabella's title being disputed by the Princess Joanna, Henry IV.'s acknowledged daughter, Ferdinand defeated Alfonso, King of Portugal, who supported her claims, at Toro in 1476. In 1479 Isabella secured undisputed possession of the kingdom by a peace with France, signed Nov. 9, 1478. In Jan., 1479, Ferdinand succeeded his father, John II., in Aragon; and immediately afterward in both kingdoms, but especially in Castile, the two sovereigns commenced salutary reforms in the administration of justice, restraining the excesses of the nobility, and checking their power as feudal lords. In 1480 Ferdinand established the Inquisition at Seville, and subsequently permitted its establishment in Aragon. He began his wars with the Moors for the possession of Granada in 1482, the Moors having in 1481 captured the fortress of Zahara in Andalusia, and on Jan. 6, 1492, with Isabella his queen, he entered Granada in triumph. The same year he issued an edict for the expulsion of all Jews from his dominions. This year also Isabella furnished to Christopher Columbus two vessels in his fleet of three, with which he discovered San Salvador. Columbus returned in Mar., 1493, and during that year Ferdinand and Isabella obtained a bull from Pope Alexander VII. confirming their title to all the territories which they should discover in the western hemisphere. In 1493 Ferdinand reacquired Roussillon and Cerdagne from Charles VIII. of France, and in 1495 opposed Charles in Italy, the Spanish troops being commanded by Gonsalvo de Cordova. In 1497 he promoted the expedition of Amerigo Vespucci. By 1500 the Spanish conquest of Naples was complete; by 1501 every Moor had been expelled from the kingdom or was compelled to be baptized. Isabella died in 1504, and in 1505 Ferdinand married Germanie de Foix, niece of Louis XII. of France. On the death of Philip, his son-in-law, he became regent of Castile in Sept., 1506. By the treaty of Cambray (Dec., 1508) he received several Venetian cities, which were incorporated with the kingdom of Naples. In Oct., 1511, he joined the Holy League against France, and Jean d'Albret, King of Navarre, having leagued himself with the French monarch, Ferdinand invaded his dominions, drove him from the throne, and in 1512 subjugated that kingdom, thus finally uniting Aragon, Castile, Granada, and Navarre under one sway. Ferdinand died Jan. 23, 1516.

Ferdinand I.: King of Naples; b. in 1423; married Isabella de Clermont in 1445; was legitimized by Pope Eugene IV., and crowned king in 1458. In a short time his subjects invited John of Anjou to take the throne, and having done so, John sustained himself for a time, but Ferdinand defeated him at Troia in Aug., 1462, and became master of the kingdom in 1463. Isabella having died in 1475, he married Joanna of Aragon in the following year. In 1486 the barons of Naples revolted. Ferdinand having made peace with them on Aug. 11, treacherously arrested and massacred them at the palace on Aug. 13. For this he was excommunicated by Pope Innocent VIII. in 1489; he made peace with the pope in May, 1492. D. Jan. 25, 1494.

Ferdinand IV.: King of Naples, and **I.** of the Two Sicilies; was b. at Naples, Jan. 12, 1751, and succeeded to the throne when his father, Don Carlos, became King of Spain Oct. 5, 1759. In 1767 he expelled the Jesuits; in 1768 married Maria Carolina of Austria. In 1777 he dismissed his Prime Minister, Tanucci; in 1793 joined the coalition against France, but in 1796 purchased peace from the Directory. In Nov., 1798, a secret alliance having been formed with Russia, Austria, and England against France, the Neapolitan army marched to Rome, but was defeated by the French, who took possession of Naples, and established the Parthenopean Republic 1799. The king and queen fled to Sicily, but during the same year were restored to power by the successes of the allies, and then took a bloody revenge on the republican citizens of Naples. Mar. 18, 1801, by the treaty of Florence, Ferdinand made peace with France, but in 1805 joined a third coalition against her. In the end of that year he was deprived of Naples by Napoleon I., and retired to Sicily under English protection. In Jan., 1812, he resigned his authority in favor of his son Francis, but on Napoleon's fall he was restored, entering the capital Aug. 14, 1815. In Dec., 1816, he took the title of King of the Two Sicilies (Naples and Sicily), but in the latter part of his reign (1820–21) was threatened with a fresh revolt of his subjects. He annulled their constitution, and entered Naples, supported by the Austrian army, May 15, 1821. D. Jan. 4, 1825.

Ferdinand I.: King of Portugal; b. at Coimbra in 1345; succeeded to the throne in 1367. In 1369 he claimed Castile, but was opposed by Henry II. of that kingdom, and after an indecisive war made peace in 1371. The war being renewed, a like issue ensued in 1373. He again warred with Castile, assisted by Edmund, Duke of Cambridge, in 1381. D. Oct. 20, 1383.

Ferdinand VII.: King of Spain; b. at St. Ildefonso, Oct. 14, 1784, and was proclaimed Prince of Asturias and heir to the crown in 1790; in 1802 he married Maria Antoinetta Theresa of Naples, who d. May 21, 1806. On the abdication of his father (Mar. 19, 1808) he succeeded to the kingdom, but was compelled by Napoleon to give up his claims May 6, 1808, and sent with his brother and uncle to the château of Valençay. On being liberated he returned to Spain Mar., 1814, and in May annulled the Spanish constitution and dissolved the Cortes; Sept. 29, 1816, he married Isabella Maria, Infanta of Portugal, who d. Dec. 26, 1818; Oct. 2, 1819, married Maria Josephine of Saxony. The French having invaded Spain under the Duke of Angoulême in Apr., 1823, Ferdinand was held a prisoner by the revolutionists, but the success of the French caused his restoration, which he celebrated by an amnesty and false promises of good government. He married the daughter of Maximilian of Saxony in 1824, and she died in 1829. The same year he married Maria Christina of Naples. Mar. 29, 1830, he reestablished the Pragmatic Sanction of 1789. D. Sept. 29, 1833.

Ferdinand II.: of the Two Sicilies; known as KING BOMBA; b. Jan. 12, 1810; succeeded his father, Francis I., in 1830; by false promises and liberal measures at first excited great hopes among the friends of liberty, which his subsequent course cruelly disappointed. The history of his reign is a catalogue of conspiracies, rebellions, executions. His reckless bombardment of Messina Sept. 2–7, 1848, won him his shameful title. D. at Naples, May 22, 1859.

Ferdinand, PRINCE of BULGARIA: b. Feb. 26, 1861; youngest son of Prince Augustus of Saxe-Coburg and Princess Clémentin, daughter of King Louis Philippe; served as lieutenant in the Austrian army until 1886; accepted the throne of Bulgaria in 1887, but was not recognized by the great powers until Mar., 1896.

Ferghana: See the Appendix.

Fergus: town; Wellington co., Ontario; on the Grand river; 10 miles N. of Guelph, and on Ellora Branch of the Canadian Pacific and the Wellington, Gray and Bruce Branch of the Grand Trunk R. Rs. (see map of Ontario, ref. 4–C). It contains mills, distilleries, manufactories, and an iron-foundry. Pop. 1,600.

Fergus Falls: city and railway center (founded in 1870); capital of Otter Tail co., Minn. (for location, see map of Minnesota, ref. 6–B); on the Red River of the North, and on the Great Northern and N. Pac. R. Rs.; 187 miles N. W. of St. Paul. It is situated in a rich agricultural country in the center of the famous "Park" or Lake region, and has 14 churches, 4 school buildings, a State high school, the Norwegian Lutheran College, fine water-power, and manufactures of flour, paper, etc. Pop. (1880) 1,635; (1890) 3,772; (1900) 6,072.
EDITOR OF "JOURNAL."

Ferguson, ADAM, LL. D.: an historian and philosopher who occupies a place of his own in the history of Scotch philosophy by his application to morals of the principles of perfection. He was born at Logierait, Perthshire, Scotland, June 20, 1723; studied at St. Andrews; read divinity in Edinburgh; was ordained in 1745; became Gaelic chaplain in the Forty-second Regiment; succeeded David Hume as keeper of the Advocates' Library in Edinburgh; was Professor of Natural Philosophy at Edinburgh 1759–64; Professor of Moral Philosophy 1764–85; was one of the commissioners sent in 1778 to the U. S. to effect a peace. Author of a *History of Civil Society* (1767); *History of the Progress and Termination of the Roman Republic* (1783); *Institutes of Moral Philosophy* (1769); *Moral and Political Science* (1792). D. at St. Andrews, Feb. 22, 1816. See *Life* by Small (1864).

Ferguson, JAMES, F. R. S.: astronomer and mechanician; b. near Rothiemay, Banffshire, Scotland, Apr. 25, 1710. His mechanical genius was developed at a very early age by investigation into the wheel and axle and the construction of a wooden clock and watch which were good timekeepers. He spent several years in Edinburgh, and in 1743 went to London, supporting himself in both places by drawing portraits. In 1747 he published a *Dissertation on the Phenomena of the Harvest Moon*, and in 1748 commenced lecturing upon astronomy and mechanics. Elected a fellow of the Royal Society in 1763, he was chosen a member of the American Philosophical Society in 1770. *Astronomy Explained* (1756) and *Lectures on Subjects in Mechanics, Hydrostatics, Pneumatics, and Optics* (1760), were among his *Works*, which were edited in 5 vols. 8vo by Sir David Brewster. The *Encyclopædia Britannica* is authority for the assertion that "in his whole life he had not received above half a year's instruction at school." D. in London, Nov. 16, 1776. See the *Life* by Henderson (1867; 2d ed. 1870).

Ferguson, JAMES: astronomer; b. in Perthshire, Scotland, Aug. 31, 1797; removed to New York Sept., 1800, and was assistant civil engineer on the Erie Canal 1817–19; assistant surveyor on the boundary commission under the treaty of Ghent 1819–22; astronomical surveyor on the same commission 1822–27; civil engineer for the State of Pennsylvania 1827–32; first assistant of the U. S. Coast Survey 1833–47; and assistant astronomer of the U. S. Naval Observatory 1847–67. He discovered during this latter service the following asteroids: Euphrosyne in Sept., 1854; Virginia in 1857; Echo in 1860, for which he was awarded the astronomical prize medal by the Academy of Sciences of France in 1854, and again, by the same institution, in 1860. Prof. Ferguson was a valued contributor to Dr. Gould's *Astronomical Journal* and to the *Astronomische Nachrichten*; also to the Episcopal *Church Review*, to the Albany *Argus*, the *Merchants' Magazine* of New York, and to other standard papers. D. Sept. 26, 1867.

Fergusson, JAMES, LL. D., D. C. L., F. R. S.: writer on architecture; b. at Ayr, Scotland, in 1808; became an indigo-planter in Bengal; journeyed in the East, and published *Illustrations of the Rock-cut Temples of India* (1845); *Picturesque Illustrations of Ancient Architecture in Hindostan* (1847); *Essay on a Proposed New System of Fortification by Earthworks* (1849); *The Palaces of Nineveh and Persepolis Restored* (1851); *History of the Modern Styles of Architecture* (1862); *Temples of the Jews and the Other Buildings in the Haram Area at Jerusalem* (1878). His *History of Architecture* (2 vols., 1865–76); *History of Modern Architecture* (i. e. since the beginning of the Renaissance), 2 vols.; and *History of Indian and Eastern Architecture* form together the most important work of the kind in English. On Apr. 17, 1871, he received the royal gold medal at a meeting of the Royal Institute of British Architects. D. Jan. 9, 1886.

Fergusson, ROBERT: poet; b. at Edinburgh, Scotland, Sept. 5, 1750; educated at St. Andrews University; took up medicine as a profession, but soon wearied of it and entered the office of the commissary clerk at Edinburgh. Much of his spare time was spent in writing verses in dialect, which were printed in a local magazine and were greatly admired. His health became impaired by dissipation, insanity resulted, and he died from the effects of a fall Oct. 16, 1774. His poems were collected in 1773, and several editions have been printed, the latest being that of Groshart (1851). Robert Burns had a profound admiration for Fergusson's talent, and imitated him to some extent, especially in the subjects of his poems. In 1789 he erected a memorial stone over Fergusson's grave.

Fergusson, Sir WILLIAM, Bart., F. R. S., F. R. S. E.: surgeon; b. at Prestonpans, East Lothian, Scotland, Mar. 20, 1808; studied under Dr. Knox and Dr. Turner in the Royal College of Surgeons at Edinburgh at the age of eighteen; and became a licentiate of that institution in 1828, a fellow of the corporation in 1829, and began to lecture on the principles and practice of surgery in 1831. In 1836 he was assistant surgeon to the Royal Infirmary, and in 1839 a fellow of the Royal Society of Edinburgh. He settled in London in 1840, having been appointed Professor of Surgery in King's College and surgeon to King's College Hospital; became Professor of Clinical Surgery in King's College, having also been elected president of the Royal College of Surgeons of England July 4, 1870, and having been for some time Professor of Surgery and Human Anatomy in that institution. These are but a few of the active and honorary positions to which he was called. His *Progress of Anatomy and Surgery in the Nineteenth Century* (1867) was the substance of two courses of his lectures. His *System of Practical Surgery* has passed through several editions; he was the inventor of numerous surgical instruments, and in 1866 was made a baronet. D. in London, England, Feb. 10, 1877. See H. Smith, *Sir W. Fergusson, a Biographical Sketch* (London, 1877).

Fe′riæ [Lat., holidays, plur. of *fe′ria*, for older **fe′sia*. See FAIR and FEAST]: in ancient Rome, those holidays whereon business could not lawfully be done and when slaves might rest from their labors. These public festivals were of many kinds and were very numerous. Marcus Antoninus fixed them at 135 in the year, though before his time they had been much more frequent. The way in which they were kept varied extremely, but in general their celebration resembled that of the Christian Sabbath, there being a religious element in their observation.

A feria in the Ordo of the Roman Catholic Church is a week-day having no feast. The feriæ of Ash Wednesday, Holy Week, Whitsun Eve, and the Octaves of Easter and Whitsuntide have the offices of Sundays of the first class. The feriæ of Advent, of Lent, the Ember Days, and the Monday of Rogation Week are called greater feriæ.

Revised by J. J. KEANE.

Ferish′tah, or **Firishta**, MOHAMMED KASIM HINDU SHAH: Persian historian; b. at Astrâbâd, 1550 or 1570; wrote the *Tarîkh-i-Firishta*, a history of the Mohammedan power in India, commencing about the close of the tenth century. In the introduction he gives an account of Indian history prior to the invasion of the Mussulmans. His history was translated by A. Dow (2 vols., 1768) and by Gen. Briggs (4 vols. 8vo, London, 1832). D. about 1612.

Ferland, făr′laañ′, JEAN BAPTISTE ANTOINE, l'Abbé: author; b. at Montreal, Canada, Dec. 25, 1805; admitted to orders in the Roman Catholic Church in 1823. He was priest and professor in Canada for several years, then superior of the College of Nicollet in 1847, afterward professor at Laval University June 10, 1855. *Observations on the History of Canada* was published in 1851; then *Notes on the Registers of Notre Dame de Quebec, A Voyage to Labrador, Courses of History of Canada from 1534 to 1633, Journal of a Voyage to the Coast of Gaspé*, and *Life of Bishop Plessis*, the last in 1863. D. at Quebec, Jan. 8, 1864.

Fermanagh, fer-măn′a: inland county of the province of Ulster, Ireland; area, 714 sq. miles. Its surface varies from the richest vales to the wildest uplands. Its rocks are mountain limestone, with many huge cavities and underground watercourses, millstone grit, and old red sandstone, with some coal, iron, and marble. In the low grounds the soil is a deep and rich loam, which grows thin and cold in the uplands. Fermanagh returns two members to Parliament. Pop. (1891) 74,037. Capital, Enniskillen.

Fermat, făr′maa′, PIERRE, de: mathematician; b. at Beaumont de Lomagne, near Montauban, France, in 1601. French savants claim for him a great part of the honor of the discovery of the differential calculus. He made important discoveries in the theory of numbers, and invented a theory of finding maxima and minima. Laplace thought Fermat ought to share with Pascal in the fame of the invention of the calculus of probabilities. His *Works* (*varia opera*) were published by his son in 1670–79. He was a councilor of the Parliament of Toulouse, and cultivated mathematics as a recreation, and is known as the first to propose two celebrated theorems called by his name. D. at Toulouse, Jan. 12, 1665.

Fermentation [Fr. *fermentation*, deriv. of *fermenter*, ferment < Lat. *fermenta′re*, deriv. of *fermen′tum*, yeast]: an obscure and seemingly spontaneous change or decomposition which takes place in most vegetable and animal substances when exposed at ordinary temperatures to air and moisture. When the process is accompanied by the liberation of fœtid gases, as in the decomposition of urine, blood, or flesh, it is termed *putrefaction*. When it occurs with free access of air, and without excess of water, it is termed *decay* or *eremacausis*, as when a fallen tree moulders into brown pulverulent humus. The term *fermentation* is limited in common language to the process as conducted for the production of inoffensive and useful products, as when grape-juice and malt-wort are fermented into wine and beer. While these processes differ widely in their products, they are all similar in their general character. The substances most liable to undergo putrefaction are compounds rich in nitrogen, such as albumen, fibrin, casein, gluten, gelatin, etc. These bodies require only the presence of water, and access of ordinary unfiltered air for a short time, to bring them into a state of putrefactive fermentation, which is very offensive, owing to the liberation of sulphuretted hydrogen, ammonia, and a variety of volatile bodies, whose exact nature has not been definitely determined. These bodies which thus appear to ferment spontaneously are composed of carbon, hydrogen, nitrogen, oxygen, and sulphur. Many non-nitrogenous substances, consisting of carbon, hydrogen, and oxygen only, which are incapable of fermenting or putrefying spontaneously, readily undergo this change when brought in contact with albuminous or gelatinous compounds, either in a fresh state or in a condition of incipient putrefaction. These latter bodies, which are capable of exciting fermentation, are called *ferments*, and bodies which are made to ferment by them are said to be *fermentable*. One of the most active of all ferments is yeast, a plant which develops in liquids undergoing vinous or alcoholic fermentation. Bodies composed wholly of carbon and hydrogen do not appear to be capable of undergoing fermentation under any circumstances. Bodies may be brought into different states of fermentation by the same ferment, according to the particular stage of decomposition which it may have attained. Thus in the raising of bread by the aid of leaven, vinous fermentation may occur, with the production of alcohol and carbon-dioxide gas (CO_2), which makes the bread light and porous, or lactous fermentation may occur, with the formation of lactic acid, which makes the bread sour and heavy. It is probable, however, that the ultimate cause in the two cases, though apparently the same, is really different. Temperature influences both the development and the character of fermentation. It can not occur at a temperature much below 40° F., nor much above 140°.

Fermentation is generally indicated by a sensible internal motion, the development of heat, and the liberation of bubbles of gas, and when it occurs in a clear liquid always results in turbidity and the formation of a scum and a sediment. During the process complex organic bodies are resolved into simpler organic bodies, as when milk-sugar is changed to lactic acid; or into simpler organic bodies and inorganic compounds, as when glucose is changed to alcohol and carbon-dioxide; or the decomposition may result in the liberation of elementary bodies, as hydrogen and nitrogen. The elements of water are often assimilated during fermentation, and enter into the composition of the new bodies. The process is always complex, and while it often results in the formation of some well-characterized predominating product, as alcohol, acetic acid, lactic acid, butyric acid, etc., there is always produced a variety of bodies in smaller quantities the exact nature of which has not been fully determined, although many of these secondary bodies have been identified. Fermenting substances generally have a tendency to abstract oxygen from the air and other bodies. When fermentation occurs with free access of air it is accompanied by oxidation (*eremacausis*) on the surface. Putrefying bodies reduce ferrous sulphate to sulphide of iron by withdrawing oxygen, and sewage is able likewise to reduce nitrates to free ammonia.

Fermentation has long been resorted to in raising bread with leaven or yeast, in preparing alcoholic beverages, and in preparing certain vegetables, as sour beans and *Sauerkraut*. It is the process, too, by which all vegetable and animal substances ultimately undergo destruction, and finally return to the inorganic world in the form of carbon dioxide (CO_2), water (H_2O), ammonia (NH_3), nitrogen (N), etc., to become again the food of plants, and under the influence of the solar rays again to generate complex organic bodies. It is the process by which milk and vegetables sour, meats putrefy, and fats become rancid, and by which timber and textile fabrics decay. It is, moreover, intimately associated with the development of contagious diseases, and its study leads to the discovery of methods for preserving food and timber and for preventing the occurrence and spread of many diseases.

There is an endless variety of processes to which the term fermentation may be applied with more or less propriety; the following are a few of the most important: (1) Vinous, alcoholic, or panary fermentation; (2) acetous; (3) lactous; (4) butyrous; (5) mucous or viscous; (6) putrefaetive; (7) saccharous; (8) glucosic; (9) pectous; (10) gallous; (11) amygdalous; (12) sinapous; (13) urinous; and (14) peptous.

I. *Vinous or alcoholic fermentation* is the process by which grape-juice is converted into wine and the wort of malt into beer. A solution of pure sugar in water may remain unaltered for a long time, but finally mould appears upon it, and it becomes sour and dark-colored. If, however, a suitable ferment is added to it, such as yeast, putrid blood, or partially decomposed flour-paste, albumen, casein, fibrin, or any similar body, it rapidly passes into a state of active fermentation, by which the sugar is converted into alcohol, carbon dioxide, etc. What has really happened here is that the so-called ferment contains not only the true ferment, but also certain nitrogenous and mineral substances, which, added to the sugar, facilitate decomposition. The sweet juices of plants contain, in addition to sugar, small quantities of albumen, gluten, and legumen, and when they are exposed to unfiltered air and maintained at a temperature of about 80° F., they appear to undergo fermentation spontaneously, the process continuing from forty-eight hours to several weeks, according to the temperature, the amount of sugar present, and the nature and quantity of the nitrogenous bodies which act as ferments. The most striking phenomena of this fermentation are—(1) the liquid becomes turbid; (2) bubbles of gas rise to the surface; (3) the temperature rises; (4) the sugar disappears; (5) alcohol makes its appearance; (6) by and by the liquid becomes clear and quiet again, and a light scum and a light-colored deposit are formed. This deposit consists of yeast, which is capable of exciting vinous fermentation in other solutions of sugar. The conditions essential to vinous fermentation are—(1) an aqueous solution of sugar, which may be either glucose, cane-sugar, or milk-sugar. The two latter are, however, invariably changed to glucose before they undergo vinous fermentation (see *Saccharous Fermentation*, page 329).

$$\underset{\text{Cane-sugar.}}{C_{12}H_{22}O_{11}} + \underset{\text{Water.}}{H_2O} = \underset{\text{Glucose.}}{2C_6H_{12}O_6}.$$

(2) The presence of yeast or of some similar nitrogenous ferment; (3) access of air, at least at the outset; (4) a certain temperature, the limits of which are 41° and 86° F. The lower the temperature the slower the process, while at the temperature of 86° the vinous fermentation is liable to pass into butyrous fermentation by the greater activity of the butyrous ferment. The chief products of the fermentation are alcohol and carbon dioxide, which might be produced from the glucose by the following decomposition:

$$\underset{\text{Glucose.}}{C_6H_{12}O_6} = \underset{\text{Alcohol.}}{2C_2H_6O} + \underset{\text{Carbon dioxide.}}{2CO_2}.$$

Were these the only products, 100 parts of glucose would yield 51·11 of alcohol and 48·89 of carbon dioxide; but as a fact only about 95 per cent. of the sugar is accounted for by these products. Most of the missing 5 per cent. is converted into succinic acid (discovered by C. Schmidt in 1847) and glycerin (discovered by Pasteur), so that the real equation of decomposition must be far more complex. In addition to these bodies, there is a host of others in minute quantities, derived partly from the glucose, partly from the ferment, and partly from the other bodies always present in vegetable solutions. The following scheme gives approximately the products from 100 parts of glucose:

Alcohol	48·5 per cent.
Carbon dioxide	46·5 "
Glycerin	3·6 "
Succinic acid	0·7 "
Acetic acid; Cellulose; Fatty substances; Hydrogen; Nitrogen; Hydrocarbon (methane ?); Propylic alcohol*; Butylic alcohol*; Amylic alcohol*; Acetate, butyrate, valerianate, and œnanthate of ethyl, amyl, etc.*	0·7 "
Total	100·0 per cent.

The last-mentioned bodies, indicated by a *, constitute, when separated by distillation, what is called the *fusel oil*.

The infusion of malt and sugar solutions to which gluten, casein, albumen, or substances of like nature are added, does not generally undergo a purely vinous fermentation; lactous, butyrous, acetous, and putrefactive fermentation also occur, and offensive products result. This can be prevented by the addition at the outset of a proper quantity of yeast, which at once determines the vinous fermentation; and if a temperature below 86° F. is maintained, and the air is properly excluded, the products of this kind of fermentation alone ordinarily result. Sometimes, however, the other (non-alcoholic) fermentations prevail to such an extent as to do damage, and thus arise the so-called "diseases" of wine and beer. (See beyond.) In the making of wine and the brewing of beer the complete destruction of the sugar is not desirable, and rarely, if ever, occurs, but in the manufacture of spirits the change to alcohol is made as complete as possible. (See WINE and BEER.) When vinous fermentation is resorted to in making bread, the object is not to produce alcohol, but carbon dioxide, which shall make the bread light. Many substitutes for fermentation are in use by which the carbon dioxide is produced without the alcohol. See BREAD.

Theories of Fermentation.—The discovery of fermentation and the preparation of wine date back beyond historic times. According to the Egyptians, Osiris, and according to the Greeks, Bacchus, taught the art to men. The Israelites attribute the discovery to Noah. The alchemists often employed the terms *fermentation* and *putrefaction*, but in a sense quite different from that in which the words are now used; the gradual solution of an inorganic body was called putrefaction, while fermentation was used as equivalent to our word *digestion*—i. e. the digestion of a mineral with an acid. The term *ferment* was applied to every active chemical agent. Valentine supposed the alcohol to pre-exist in the wort, and to be simply set free during fermentation. Libavius believed fermentation and putrefaction to be similar processes, differing merely in their products. Van Helmont (1648) attributed to fermentation the formation of gases during digestion, also the formation of the blood and of the sap. He considered fermentation to be the cause of the formation of living organisms, and of their reproduction and development. Mayow (1669) noticed the importance of air to fermentation. Sylvius de le Boë (1659) claimed that fermentation differed entirely from the action of acids upon alkalies (carbonates). He says the latter results in combination, while fermentation results in decomposition. Lemery (1775) recognized a similar distinction. Becher (1669) considered fermentation as similar to combustion (separation of phlogiston from calx) and as resulting in a splitting up of the fermenting body. Willis (1659) and Stahl (1697) considered fermentation and putrefaction similar processes, and attributed them to the action of a ferment—a body possessed of internal motion, which motion it communicated to the fermentable bodies.

The modern theories of fermentation have been developed as knowledge of the conditions and products of the process has become more accurate. The production of alcohol attracted attention very many centuries ago. Van Helmont (1648) noticed the gas liberated during vinous fermentation, and called it "gas vinosum," to distinguish it from "gas carbonum," produced by coal. He recognized the fact that during fermentation something disappears or evaporates (sugar), which could otherwise be changed to coal (charcoal). He says *fermentum volatilisat quod alias in carbonem mutatur*. McBride (1764) showed that fermentation and putrefaction yielded the gas called "fixed air" by Black, and Cavendish (1776) showed that sugar yielded 57 per cent. (correctly 48·89) of the same gas which is obtained from marble. After the discovery of oxygen, hydrogen, and nitrogen, of the composition of water and of the atmosphere, and the elementary composition of vegetable and animal bodies, and the recognition of the true character of combustion, Lavoisier (1789), in his *Traité élémentaire de Chimie*, exhibited the quantitative relations of cane-sugar to its products on fermentation. He assumed that sugar, an oxide, was split into two products, the gas and the alcohol, which, if they could reunite, would regenerate the sugar. Berthollet (1803) believed that the alcohol had no isolated existence in the wine, but that, excluding the argol and the acids, the wine was a homogeneous body, in which alcohol was produced by heat. Brande (1811) and Gay-Lussac (1813) proved the pre-existence of alcohol in wine. The further investigation of the nitrogenous ferments, and finally the study of the yeast-plant, have given us the following definite theories of fermentation: (1) *acid theory*; (2) *contact theory*; (3) *influence theory*; (4) *chemical theory*; (5) *galvanic theory*; (6) *germ theory*.

1. *The Acid Theory.*—Pliny considered the action of leaven in raising bread to be due to an acid. Fabroni, in his prize essay on fermentation, published at Florence in 1787, claims that fermentation depends on the action of a vegetable acid on sugar. He afterward advanced the theory that the ferment is a vegeto-animal body, like gluten, and that the products result both from the sugar and from the ferment—the carbon of the ferment and oxygen of the sugar forming the carbonic acid, while the deoxidized sugar forms alcohol with the hydrogen and nitrogen of the ferment. The acid theory was long since disproved by the fact that fermentation occurs in the presence of calcic as well as of alkaline carbonates, and of metallic oxides.

2. *Contact Theory.*—Berzelius supposed that fermentation is due to the contact or *catalytic* action of the ferment, in

the same way that platinum sponge was supposed to effect the union of alcohol and the oxygen of the air, and sulphuric acid was formerly supposed to change alcohol to ethylic ether. As these reactions have already received more rational explanations, the idea of catalysis has been generally abandoned.

3. *Influence, Contagious, Mechanical, or Physical Theory.*—This theory originated with Stahl, and was re-established by Liebig in 1839, and was held by Pelouze, Frémy, Gerhardt, etc. It attributes fermentation to the mechanical action of certain nitrogenous matters (ferments), which are themselves in a state of decomposition, which is imparted to the sugar as soon as it comes in contact with the decomposing ferments under favorable circumstances. The more changeable body, by its own inherent instability, initiates molecular movements in a more permanent compound. The action is compared to several inorganic reactions, as the solution in nitric acid of platinum when alloyed with silver, platinum alone being insoluble; the decomposition of hypochlorous acid, chloride of nitrogen, peroxide of hydrogen; action of pyroracemic acid on argentic carbonate; the kindling of combustible bodies; crystallization from supersaturated solutions by rubbing the side of the vessel with a rod or introducing angular particles. The yeast-plant is supposed by the advocates of this theory to be only an incidental product of some varieties of fermentation, and to be active in inducing fermentation only in that it contains decomposing albuminous substances. The access of air is by them supposed to be necessary only to initiate by oxidation the activity of the ferment.

4. *The chemical theory* supposes a purely chemical action of the ferment or yeast on the sugar. It was founded by Trommsdorff and Meissner, but has at present few if any adherents.

5. *The galvanic theory* assumes that the decomposition is called forth by the dualism of the exciting body in a conducting fluid. Its adherents are Schweigger, Colin, and Kölle.

6. *The Germ, Vital, or Physiological Theory.*—This theory, which is the one which is generally accepted, attributes the decomposition of the fermentable body to the vital action of minute living organisms, the vegetable cells of the yeast-fungus. These plants are introduced in relatively small numbers from without either accidentally, as in the fermentation of wine and apple-juice, or intentionally, as in the process of brewing or bread-raising. They immediately begin to grow and to multiply at the expense of the nitrogenous substances present in the grape-juice, beer-wort, or other fermenting material, and involve the consumption and consequent destruction of the sugar, and the production of a variety of products of which in vinous fermentation, alcohol, carbon dioxide, glycerin, and succinic acid are, as already stated, the most abundant. "It is now fully established that (1) the growth and reproduction of the yeast-fungus takes place only in fermentable liquids; (2) that the saccharine liquid will only ferment when the yeast-plant [or some similar ferment] is present in a state of active development."—*Dalton.* This view is now so well established that any process which is proved to proceed without the development of living organisms must be excluded from the class of decompositions known as fermentation.

The Yeast-plant.—In 1680 Anthony Leeuwenhoeck, with his newly invented microscope, discovered the fact that yeast consisted of "little globules collected into groups of three or four together." Fabroni (1787), as already stated, considered the yeast to be a "vegeto-animal" body, like gluten. Fourcroy entertained the same idea. In 1803 Thénard stated that yeast contains a nitrogenous "animal" substance common to all ferments. Mulder (1844) endeavored to show that a peculiar nitrogenous body, which he called *protein*, was essentially characteristic of living matter, and was nearly allied in chemical composition to albumen, casein, fibrin, and gluten. Payen in 1846 recorded the opinion that all vegetable cells contain materials similar in composition to animal organisms; and in the same year von Mohl, a German botanist, invented for the active compound in living vegetable cells the term "protoplasm." The true relation of the yeast-cells to fermentation was recognized by Thénard in 1803. He then first enunciated the "germ theory," by assuming that the yeast assimilates a little of the sugar, while the rest breaks up into alcohol and carbon dioxide. The same idea was maintained by Erxlebens in 1818, and in 1825 Desmazières examined the yeast-cells of beer and of wine, and called them animals. These investigations attracted comparatively little attention, even after Cagniard de la Tour in 1837 rediscovered the yeast-plant, made some most important observations upon it, and "declared that by some effect of their vegetation the equilibrium of the sugar was destroyed." He measured the yeast-cells and found them to be about $\frac{1}{2500}$th of an inch in diameter; and he also noticed that by a process of budding they multiplied during fermentation, and increased six or seven fold. Schwann made similar observations in the same year; Kützing investigated the subject; and Turpin, in 1838, made an elaborate botanical study of beer-yeast, which he considered to belong to the genus *Torula*—a name still often applied to yeast. All of these writers considered yeast organisms to be alone capable of initiating fermentation. Mitscherlich adopted this view, and referred fermentation to vegetable organisms, and putrefaction to minute animals. Helmholtz, in 1843, made a remarkable confirmatory experiment: he placed a quantity of yeast on one side of a film of bladder, and a solution of sugar on the other, and although the liquids circulated freely through the membrane, the yeast could not pass, and fermentation took place only on the side of the yeast. Nevertheless, owing to the powerful influence of Liebig and to the contempt and ridicule with which he met all the evidence offered by these and other observers, the "influence" theory of Liebig was generally accepted, until through the most elaborate and conclusive investigations of Pasteur it was overthrown, and the germ theory or vitalistic theory was finally established. Pasteur says: "Albuminous bodies are never the ferments, but the aliment of the ferments"; "the true ferments are living organisms."

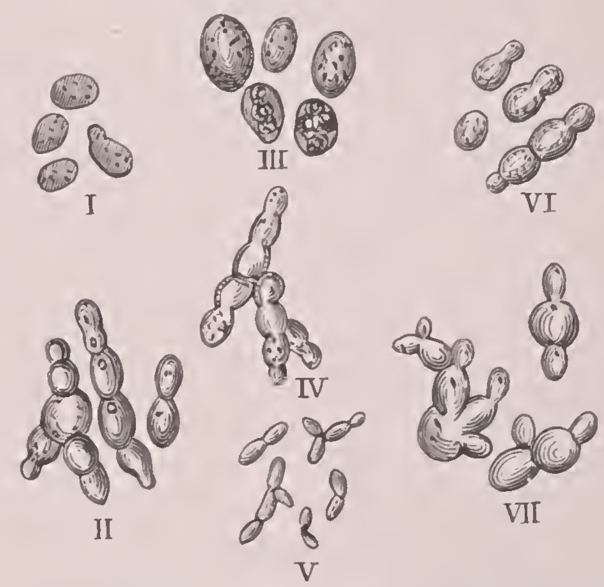


FIG. 1.—Beer-yeast, Reess: *Saccharomyces cerevisiæ.* I. Top yeast; III. Top yeast, developing ascospores; II., IV. Top yeast, fully developed; VI. Bottom yeast; VII. Bottom yeast, cultivated at 61° to 65° F. *Saccharomyces exiguus*; V. The yeast of the after-fermentation.

The study of this subject has expanded far beyond its original limits, and has involved the questions of spontaneous generation and the germ theory of disease, which are now engrossing the attention of the most acute observers on both sides of the Atlantic. This arose from the necessity of accounting for the presence of the living yeast-cells in fermenting and putrefying liquids, which decompose spontaneously without the addition of yeast. Appert, who studied early in the nineteenth century the preservation of vegetable and animal food, found that by boiling such perishable articles, and sealing them up so as to exclude the air, they could be preserved indefinitely. This was explained by many by supposing that the oxygen of the air, which is necessary to initiate decomposition, was excluded. It was long supposed that a large number of animals were produced spontaneously. Aristotle supposed that shellfish, sponges, maggots, worms, moths, eels, etc., were produced without parents, and the idea that putrefaction is peculiarly favorable to the production of life was entertained by him, repeated by Pliny four centuries later, by Fabricius in 1600, Harvey in 1650, and is now held by the advocates of spontaneous generation. In the year 1668, Francis Redi, an Italian, showed that maggots in meat were the progeny of flies. His experiments were important, as they demonstrated the fact that insects were produced from eggs. As investigations continued, the idea of spontaneous generation was narrowed down to include only the microscopic organisms, the Infusoria. Needham, in 1748, wrote that he had seen them produced from decaying organic matter. He boiled solutions containing animal matter, corked them hot to exclude air, and found after a few days that they were full of living organisms, whose origin he attributed to "vegetative force" residing in the solutions. Spallanzani, in 1776, repeated these experiments in glass flasks, with more care, and satisfied himself that the germs of life entered the solutions from the air. Schultze, in 1836, successfully repeated the experiments, renewing the air, but subjecting it on its way to the flasks to the action of sulphuric acid or caustic potassa, to destroy the vitality of any germs it might contain. Schwann, in the following year, varied these experiments by passing the air into the flasks through tubes heated to 600° F. They showed that the Infusoria were not produced spontaneously, but from spores or germs floating in the air. Schroeder and Dusch in 1854, and Schroeder alone in 1859, went still further, and found that if the air admitted to the flasks was merely filtered through cotton plugs, it failed to induce decomposition and develop animal or vegetable organisms. Pasteur employed guncotton for the filter, dissolved it, and detected germs on the cotton plugs by the microscope, and found that when the plugs were placed in suitable solutions they at once gave rise to numerous animals and fungi. Dr. Lemaire, in 1864, collected germs by condensing the moisture of the air in glass tubes cooled by ice, and Tyndall showed that the floating particles made visible in the air by a beam of light may contain the germs of putrefaction. It was thus established that the germs of the yeast-fungus and of Infusoria float in the air, fall into organic solutions, and give rise to fermentation and putrefaction, and, as many think, to infectious diseases. There are still, however, some advocates for the theory of spontaneous generation, who base their belief on the experiments of Wyman, Bastian, Cantoni, and others, who claim to have seen living organisms develop in sealed flasks which had been exposed, after sealing, to temperatures varying from 140° to 300° F. The facts upon which the theory of spontaneous generation is based are, however, now more easily explained as errors of experiment, e. g. in the cases first cited, by imperfect sterilization by heat.

FIG. 2.—Wine-yeast, Reess: VIII., IX., X. *Saccharomyces ellipsoideus*; XI. *S. apiculatus*; XII. *S. Pastorianus*; XIII. *S. conglomeratus*; XIV. *S. reessii*; XV. *Mucor racemosus*, bullet-yeast.

The yeast-fungus consists of little cells composed of cellulose, containing a protoplasmic fluid, in which may be seen granules or germinal cells; it multiplies by budding (gemmation). The name *Torula* or *Torvula cerevisiæ* was first applied to it; it was subsequently called *Mycoderma vini*, *Cryptococcus*, *Hormiscium*, etc. Dr. Max Reess, who was one of the first to make an elaborate study of the subject (*Botanische Untersuchungen über die Alkoholgährungspilze*, Leipzig, 1870), found that there is a variety of yeast-fungi, and adopted for the genus the name *Saccharomyces*, proposed by Meyen, which has been generally adopted. Beer-yeast is *S. cerevisiæ*, which develops in two different ways, according to the temperature. At about 72° F., as in the brewing of ale, the fermentation is rapid, and the yeast is carried to the surface of the liquid by the bubbles of carbon dioxide; this is *top yeast*. When the fermentation proceeds at a temperature between 40° and 50° F., in brewing lager beer, it proceeds much slower, and the yeast appears as a sediment—*bottom yeast*. (See BEER.) These two varieties have a tendency to reproduce the kind of fermentation by which they were developed; and if the bottom yeast is placed in wort at a temperature of 72° F., it does not develop into top yeast, although its mode of growth is considerably modified. The after-fermentation of beer is caused by the development of another species, *S. exiguus*, the smallest of all yeast-fungi.

According to Reess and others, there is a greater number of species noticed in the fermentation of wine; *S. ellipsoideus* is the most common, and often the only form seen. Next in order of frequency occurs *S. apiculatus*. Engel insists that this form belongs to a different genus, and calls it *Carpozyma apiculatus*. During the after-fermentation of wines, especially of sweet wines and of other wines than the grape, *S. pastorianus* appears. *S. conglomeratus* is often noticed at the beginning of the fermentation. *S. reessii* occurs in some red wines. One or two familiar mould-fungi, *Mucor mucedo*, and especially *M. racemosus*, have the property, in the total exclusion of the air, of developing their mycelium in sugar solutions in more or less globular forms, producing true alcoholic fermentation. This was formerly considered as a confirmation of the suggestion made by certain observers, that the yeast-fungus is developed from the spores of common mould-fungi, like *Penicillium glaucum*, etc. Fitz noticed that when the quantity of alcohol reached 3½ per cent., the development of the *Mucor* ceased.

The whole subject has taken on a highly practical aspect since the labors of Pasteur established the germ theory of fermentation. Pasteur showed that beer and wine are subject to certain diseases due to the influence of germs other than yeast (bacteria). He therefore urged that yeast be cultivated in a "pure" condition—i. e. free from bacteria—and placed the art of brewing on a scientific basis. More recently Hansen, in an elaborate series of papers, has carried these ideas into practice, so that in brewing "pure cultures" of yeast are now very widely employed.

The chemical composition of yeast has not been very fully determined. It consists chiefly, as do all plants, of cellulose, albuminoids, fat, and metallic salts. It contains no chlorophyll. An elementary analysis gives about the following percentages: carbon, 48·9; hydrogen, 6·8; nitrogen, 10·8; oxygen, 29·9; sulphur, 0·6; ash, 3. Some analyses make the ash in dry yeast as high as 7 or 8 per cent. The ash consists chiefly of potassic phosphate, with small quantities of sodic, calcic, magnesic, and ferric phosphates.

II. *Acetous Fermentation.*—While it is true that alcohol and other organic bodies may be readily oxidized to acetic acid without the aid of fungi, as when platinum-black, containing condensed oxygen, chromic acid, nitric acid, hypochlorous acid, etc., is employed, it is nevertheless true that in the ordinary process of vinegar-making there is a true fermentation, caused by a peculiar fungus, the *Mycoderma aceti*, which acts as a carrier of oxygen. Pure diluted alcohol does not undergo oxidation to acetic acid when exposed to the air. Like all other fungoid plants, the *M. aceti* requires food in the form of nitrogenous bodies and mineral salts, which are always present in wine, beer, and other fermented vegetable juices. The formation of vinegar is always preceded in such cases by the development of the plant, either from small additions from a previous fermentation or from germs from the air. The plant acts as a carrier of oxygen from the air to the alcohol, and the oxidation occurs in two successive stages; alcohol becomes aldehyde by the loss of hydrogen (withdrawal by oxygen), and then passes into acetic acid by a gain of oxygen.

$$\underset{\text{Alcohol.}}{C_2H_6O} + O = \underset{\text{Aldehyde.}}{C_2H_4O} + H_2O.$$

$$\underset{\text{Aldehyde.}}{C_2H_4O} + O = \underset{\text{Acetic acid.}}{C_2H_4O_2}.$$

In the quick vinegar process considerable losses occurred at first from the evaporation of the very volatile aldehyde, which escaped conversion into acetic acid from a deficient supply of air. The conditions most favorable to the formation of acetic acid by fermentation are—(1) a sufficient dilution; the fluid should not contain more than 10 per cent. of alcohol, nor should it be much below 4 or 5 per cent.; (2) the presence of nitrogenous and saline bodies; (3) the presence of the *M. aceti* added from a previous operation; (4) a suitable temperature, not above 36° C. (96·8° F.), nor below 10°C. (50° F.); below 7° C. (44·6° F.) the formation of vinegar no longer takes place. Above 40° C.

(104° F.) it takes place very rapidly, but there is a considerable loss of alcohol and acid by evaporation; (5) a plentiful supply of air, with an extended surface of liquid for its ready contact. The progress of the fermentation is indicated by the development of the fungus, a rise of temperature, an increase of the specific gravity, the disappearance of alcohol, and the sour taste of the acetic acid. The plant acts best when it simply spreads over the surface. If it becomes diffused through the liquid, its action proceeds too far, and the acetic acid is in turn oxidized and destroyed. This second fermentation or putrefaction, which may be caused by other species of bacteria, is most liable to occur in vinegar made from malt or stale beer, and is attributed to the presence of large quantities of nitrogenous bodies. Vinegar-makers believed that this putrefaction could be prevented by an addition of sulphuric acid, and in England they were allowed by law to add $\frac{1}{1000}$ by weight. Although it is now known that this practice is unnecessary, it is still continued. In practice, acetic acid is made chiefly from wood by distillation, but large quantities of vinegar are still made by acetous fermentation. The materials employed are wine, malt, sour beer, cider, sugar, molasses, and spirits. Dr. Stenhouse has shown that when seaweeds are subjected to fermentation at 96° F. in the presence of lime, acetate of lime is found in large quantities, from which acetic acid can be readily extracted. See VINEGAR.

III. *Lactous fermentation* occurs in milk which has been allowed to stand, the milk-sugar changing to lactic acid.

$$\underset{\text{Milk-sugar.}}{C_{12}H_{22}O_{11}} + H_2O = \underset{\text{Lactic acid.}}{4C_3H_6O_3}.$$

The milk is at the same time coagulated by the lactic acid formed, which neutralizes the alkali by which the casein is held in solution. By the addition of carbonate of lime, oxide of zinc, etc., the lactous fermentation is not prevented, but the lactic acid being neutralized as soon as it is formed, the coagulation of the milk is prevented. Glucose and cane-sugar are also capable of undergoing lactous fermentation.

$$\underset{\text{Glucose.}}{C_6H_{12}O_6} = \underset{\text{Lactic acid.}}{2C_3H_6O_3}.$$

$$\underset{\text{Cane-sugar.}}{C_{12}H_{22}O_{11}} + H_2O = \underset{\text{Lactic acid.}}{4C_3H_6O_3}.$$

Albuminous substances, which at an advanced stage of putrefaction act as alcoholic ferments, often induce lactous fermentation at a certain period of decomposition. The azotized matters of malt, when suffered to putrefy in water for a few days, induce lactous fermentation, while in a more advanced state of putrefaction they cause vinous fermentation. The gluten of wheat flour, which is the active agent in leaven, behaves in the same manner. When wheat flour is made into a paste with water, and left for four or five days in a warm place, it becomes a lactous ferment; if left a few days longer, it acts as an alcoholic ferment. This accounts for the uncertainty which attends the use of leaven for raising bread: when it acts as a vinous ferment the bread is light, porous, and spongy: when it causes lactous fermentation, the bread is heavy and sour. (See BREAD.) Cheese, glue, urine, and many other substances containing more or less nitrogenous matter induce lactous fermentation under certain conditions. The same property is possessed by many animal membranes in a certain state of decomposition. The most active of these is the inner coat of the stomach of the sucking calf, called rennet. This is the agent employed to coagulate milk in the manufacture of cheese. The stomach, bladder, etc., of the dog possess the same property. Lactous fermentation occurs between 58° and 104° F.; a temperature of from 75° to 90° F. is probably the most favorable. Lactous fermentation is often accompanied by vinous fermentation, the product exhibiting the products of both, with an evolution of carbonic acid (CO_2). Butyrous fermentation often occurs at the same time, with an evolution of hydrogen and carbonic acid and the formation of butyric acid. Mannite, a product of mucous fermentation, is said to occur among the products of lactous fermentation, but it is not clear whether this is also a product of this fermentation or is an evidence of mucous fermentation.

According to Pasteur (*Ann. Chem. Phys.* [3], li. 298; lii. 404), lactous fermentation is caused by the common mould-fungus (*Penicillium glaucum*) which develops in solutions containing milk-sugar, cane-sugar, or glucose, and the necessary nitrogenous matters and mineral salts, just as the vinous fermentation is caused by the yeast-fungus. Pasteur collected this plant as a gray sediment formed during lactous fermentation, and introduced it into a cooled filtered decoction of beer-yeast, with from 15 to 20 pints of water, together with chalk, and sugar equal to from $\frac{1}{20}$th to $\frac{1}{15}$th of the liquid. On keeping this mixture at from 86° to 95° F. for some days, a brisk effervescence of carbonic acid and hydrogen took place, the chalk dissolved in the lactic acid formed, while the liquid became turbid and deposited a sediment. This sediment, a purer form of the fungus, produced lactous fermentation within an hour in a solution of sugar containing chalk. When air is excluded from solutions which otherwise undergo lactous fermentation, or is supplied through heated tubes, fermentation does not occur, because the germs of the *P. glaucum* do not gain admission. The lactous ferment resembles in mass ordinary beer-yeast. It is gray, somewhat glutinous, and appears under the microscope to consist of minute spherules $\frac{1}{15000}$th to $\frac{1}{10000}$th inch in diameter—some isolated, others in groups. It increases at first by the formation of new round cells, but afterward by the formation of elongated and branched groups, which ultimately cover the surface like a white mould. A small quantity of lactous ferment is capable of decomposing a large quantity of sugar, provided the liquid is kept neutral by chalk, which forms calcium lactate; otherwise its action on the sugar is retarded by the presence of the free acid. If no other ferment is present, the lactous fermentation goes on regularly, and often more quickly than vinous fermentation. According to Blondeau (*J. Pharm.* [3], xii. 257), the liquid becomes viscous previous to lactous fermentation, in consequence of the development of the *P. glaucum*, whose ramifications fill the liquid.

The name *Oïdium lactis* has been given to a peculiar mould-like fungus often found in sour milk. De Bary, in his *Ueber Schimmel und Hefe*, insists that the *O. lactis* is a distinct plant, not to be confounded with *P. glaucum*. Reess (*Botanische Untersuchungen über die Alkoholgährungspilze*, p. 2) and Mayer (*Lehrbuch der Gährungschemie*, p. 162) insist that the true lactous ferment is a minute bacterium, which the latter figures, and that the mould-fungus, called *P. glaucum* and *O. lactis*, is merely an incidental growth. Béchamp claimed to have shown that the germs of the real ferment were contained in the chalk used in lactous fermentation. He called the fungi *Microzyma cretæ*. His conclusions are disproved by the fact that oxide of zinc, chemically prepared, may be substituted for the chalk without modifying the character of the fermentation; and also by the experiment of O. Loew, of heating the chalk red hot previous to introducing it into the liquid. (*American Chemist*, i. 244.) The most recent and probable view of these somewhat contradictory phenomena is that various micro-organisms may under favorable conditions convert lactose into lactic acid. It is known, for example, that the common intestinal bacillus of man (*B. coli communis*) can do this, although a form closely resembling it—the bacillus of typhoid fever—is unable to do so.

Lactous fermentation is conducted in the following manner for the production of lactic acid: To 2 gal. milk are added 6 lb. raw sugar, 8 oz. putrid cheese, and 4 lb. chalk. The mixture is placed in a loosely covered jar, and maintained at a temperature of about 86° F., with occasional stirring. After two or three weeks the process is complete, and a semi-solid mass of calcium lactate is the result, from which lactic acid is readily prepared. By substituting oxide of zinc for the chalk, zinc lactate is obtained. A certain quantity of mannite is formed at the same time. The spontaneously developed fermentation of saccharine juices is sometimes lactous, sometimes vinous, more frequently both together. Lactous fermentation is the process by which articles of food are so often spoiled when they are said to become sour; it is also the process by which the German *Sauerkraut* and *Sauerbohnen* are prepared.

IV. *Butyrous fermentation* sets in when lactous fermentation is allowed to proceed beyond the point indicated by the formation of calcium lactate. The calcium lactate redissolves, carbonic acid and hydrogen are evolved, and calcium butyrate is found in the solution.

$$\underset{\text{Lactic acid.}}{2C_3H_6O_3} = \underset{\text{Butyric acid.}}{C_4H_8O_2} + 2CO_2 + 2H_2$$

A temperature of 100° F. or more seems to favor this fermentation. By adding to calcium lactate a certain quantity of cheese, and maintaining an elevated temperature, butyrous fermentation is induced, and the lactate is converted into calcium butyrate, with some valerianate and acetate. (Williamson, *Chem. News*, xxii. 236). Blondeau refers butyrous fermentation to *Penicillium glaucum*, but Pasteur (*Compt. rend.*, lii. 344; liv. 416) refers it to minute bacteria or vibrios. They appear as small cylindrical stems, rounded at the ends, usually straight, and occurring singly or in chains of two, three, or more, $\frac{1}{12000}$th of an inch in thickness, a single stem varying from $\frac{1}{12000}$th to $\frac{1}{1200}$th of an inch in length. They increase by division, and may be sown and cultivated in a suitable medium like beer-yeast. Sugar or lactates, with ammonia salts and phosphates, constitute the necessary food of the plant. (*Bull. Soc. Chim.*, 1862, p. 52.) As soon as the lactate is all converted, the vibrios die. Here also it is probable that various micro-organisms are able under favorable conditions to produce butyric acid, and that its production is not the specific privilege of any one form. *American Chemist*, ii. 371.

V. *Mucous* or *viscous fermentation* occurs in solutions of cane-sugar under the influence of nitrogenous bodies, and in contact with the air, under circumstances not fully investigated. Carbonic acid gas and hydrogen are evolved, and the sugar-cane is converted into mannite, a peculiar gum, and a mucilaginous substance. The ferment is composed of spherules about $\frac{1}{20000}$th of an inch in diameter. When these are added to 100 parts of cane-sugar in water, with some albumen, 51·09 parts of mannite and 45·5 parts of gum are obtained, which corresponds to

$$\underset{\text{Cane-sugar.}}{25C_{12}H_{22}O_{11}} + 13H_2O = \underset{\text{Mannite.}}{24C_6H_{14}O_6} + \underset{\text{Gum.}}{12C_{12}H_{20}O_{10}} + 12CO_2.$$

Although often accompanied by vinous and lactous fermentation, mucous fermentation may occur without the formation of either alcohol or acid. It occurs at temperatures ranging from 68° to 104° F. The juice of the sugar-cane, sugar-beet, mangold wurzel, carrot, dandelion, etc., is liable to undergo this form of fermentation spontaneously when exposed to the air. Effervescing lemonade, made from sugar, citric acid, oil of lemon, and carbonic acid, loses its fluidity on long keeping from this kind of fermentation. The most recent view of the several fermentations just described is that, given the proper raw material, acetic, lactic, or butyric acids, or mannite, will be formed by the bacteria present, although some kinds are certainly more adapted to a particular work than others are.

When yeast is washed with cold water, then boiled with water, and $\frac{1}{20}$th part of sugar added to the filtrate, the liquid undergoes fermentation for a week or two, evolving hydrogen, carbonic acid, and carbonic oxide, and becoming turbid and tenacious like a decoction of linseed. Water boiled with gluten produces a similar change in solutions of cane-sugar. When the fermentation is completed, the liquid is still sweet, but is so thick that it runs out in threads when the vessel is inverted. The gum produced resembles gum arabic, but is less soluble in water, makes a thicker mucilage, but yields scarcely any mucic acid when treated with nitric acid. Pasteur, *Bull. Soc. Chim.*, 1861, p. 30; Hochstetter, *J. pr. Ch.*, xxix. 30; Plague, *J. Pharm.*, xxvi. 248; Kircher, *Ann. Pharm.*, xxxi. 337; Desfosses, *J. Pharm.*, xv. 602; Vauquelin, *Ann. Chim. Phys.*, xx. 93.

VI. *Putrefaction*, or putrefactive fermentation, is the process by which azotized animal and vegetable substances undergo decomposition spontaneously, with the production of offensive gases. The essential conditions are the presence of moisture, a temperature between 32° and 140° F., and exposure to the air during or previous to the process. The process is very complicated, resulting in the formation of carbonic acid, sulphuretted hydrogen, phosphuretted hydrogen, marsh gas, ammonia, nitrogen, hydrogen, acetic, lactic, butyric, and valerianic acids, and many offensive bodies which have not yet been identified. Resins, if present, are but little changed, and fats often resist all decomposition save saponification, remaining as free fatty acids for years. (See ADIPOCERE.) The process varies considerably with the quantity of water present and the extent to which air has access. Two theories were formerly advanced to account for putrefaction. Liebig claimed that "when the life-power or vital force has ceased to control the organic combinations, the nitrogen in the albuminous bodies, by its affinity for hydrogen, decomposes water, with the formation of ammonia." "The molecule set in motion by this affinity imparts its motion to other molecules with which it is in contact." A few investigators still hold that the true putrefactive ferment is an albuminoid substance not endowed with vitality. (Panum, in *Virchow's Archiv für path. Anat.*, 1874.) The theory generally accepted, however, is that of Schwann, Pasteur, and Cohn, which describes putrefaction as a chemical process induced by bacteria. The bacteria bear the same relation to putrefaction that the yeast-plants bear to alcoholic fermentation, the *Bacterium termo* (Fig. 3, 2) being one of the most common species. If a clear solution of any nitrogenous animal or vegetable matter, such as an infusion of hay, be exposed to the air at ordinary temperatures, it will soon become turbid, and exhibit the usual signs of decomposition, evolving offensive gases. The microscope shows the turbidity to be caused by innumerable bacteria, which move in every direction and multiply by division. After a time putrefaction ceases, the liquid becomes clear, and a sediment of bacteria is found to have separated. The smallest portion of this sediment will excite putrefaction in another albuminous liquid, just as yeast causes fermentation. Any process by which the access of bacteria germs to the albuminous solutions can be prevented is found to protect them from putrefaction. Dr. Burdon-Sanderson has shown (*13th Rep. Med. Officer of the Privy Council*) that contamination by germs of bacteria usually occurs from contact with water and moist surfaces, not directly from the air, while the germs of the mould-fungi enter directly from the atmosphere. This is now known to be subject to many exceptions, although it is a fact that the bacteria settle more rapidly than mould-germs, probably because they have greater specific gravity. Substances protected from bacteria germs mould, but do not putrefy. A piece of muscle cut out of a recently killed animal with a knife which had just been heated was hung under a bell-jar, and after thirty-one days, although overgrown with mould-fungi, *Penicillium*, etc., it showed no signs of bacteria or putrefaction. In the ordinary process of decay the putrefaction occasioned by bacteria is accompanied by the action of the mould-fungi, the organisms themselves being subsequently destroyed by similar agencies, other bacteria, and fungi, till nothing remains save brown humus (see HUMUS) and the mineral salts, the carbon, hydrogen, nitrogen, sulphur, and oxygen passing into the atmosphere or washed into the soil as carbonic acid, ammonia, water, etc.

Bacteria, *Vibriones*, *Microzymas*, *Microzoaires*, *Mycoderma*, etc., were first recognized by Kircher about 1650 and next by Leeuwenhoeck in 1684. O. F. Müller in the eighteenth century recognized and described the most important forms, and Ehrenberg in 1830 established for them the family of *Vibrionidæ*, which Dujardin in 1841 placed as the first and lowest form of Infusoria. They were first supposed to be animals—at least those which are endowed with motion—but all are now regarded as plants. Ferdinand Cohn established their vegetable character and structural relations. (*Nova Acta Ac. Car. Leop. nat. cur.*, xxiv. 1, 1853), and subsequently added much to the knowledge of their classification and general physiology. (*Beiträge zur Biologie der Pflanzen*, Heft. ii. p. 127. 1872.) The bacteria consist of cells composed of cellulose or a body similar to it, containing protoplasmic matter, but no chlorophyll. They are spherical, oblong, cylindrical, curved or twisted, isolated or connected in chains. They are extremely minute, taxing the powers of the best immersion lenses. The *Bacterium termo* is $\frac{1}{500}$th mm., or $\frac{1}{12000}$th inch, in length, and $\frac{1}{1000}$th mm., or $\frac{1}{24000}$th inch, in diameter; according to Cohn 41,000,000,000 weigh one grain. They multiply by division or scission, neither buds nor spores having been detected. Cohn, believing that they divide once every hour, finds that one bacterium will by doubling every hour produce in 24 hours $16\frac{1}{2}$ millions bacteria; in 2 days, 281 billions; in 3 days, 47 trillions; and in a week a number expressed by 51 figures. Spores (so called) consisting of spherical masses of protoplasm are formed in the interior of some bacteria, and when set free sink to the bottom of the liquids. Most bacteria are killed

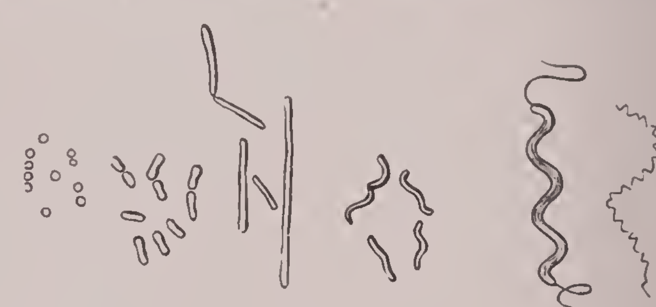


FIG. 3.—Bacteria.

by an exposure to 140° F. for several hours, to 212° for 10 or 15 minutes, to 215° for 4 or 5 minutes. Near the freezing-point the movements stop, but are resumed again on warming to 40° or 45° F. Billroth finds that the spores described by him retain their vitality after freezing, boiling, and drying. He has some which were kept eight years without losing their power of producing bacteria. To kill them he employs a temperature of 302° F. In general boiling destroys and cold suspends the activity of bacteria; but to destroy all bacteria (including spores) by mere boiling has been found practically impossible. Bacteria live upon albuminous ammonia or urea and carbonaceous matters, organic acids, sugar, etc., and require mineral salts. They are supposed to absorb oxygen and exhale carbonic acid.

Cohn subdivided the bacteria into six genera, distributed among four families:

I. Family, *Sphærobacteria* (spherical bacteria).
 1. Genus, *Micrococcus* (Fig. 3, 1).
II. Family, *Microbacteria* (short rods).
 2. Genus, *Bacterium proper* (Fig. 3, 2).
III. Family, *Desmobacteria* (thread-like).
 3. Genus, *Bacillus* (Fig. 3, 3).
 4. Genus, *Vibrio* (Fig. 3, 4).
IV. Family, *Spirobacteria* (corkscrew-like).
 5. Genus, *Spirillum* (short, stiff screws, Fig. 3, 5).
 6. Genus, *Spirochæte* (flexible spirals, Fig. 3, 6).

For a description of the species, see *Beit. z. Biol. d. Pflanzen*, ii. p. 146. See also BACTERIOLOGY.

Modern investigations have shown that bacteria may exist in the interior of living animals, that they often exist in the body during various diseases, and that healthy animals may be inoculated with them as with a virus. The germ theory of fermentation established by the labors of Schwann, Schroeder, and Dusch, and above all others by Pasteur, led inevitably to the germ theory of infectious disease (see GERM THEORY), now almost universally accepted. This theory assumes that such diseases as smallpox, diphtheria, malignant pustule, septicæmia, cholera, typhus and typhoid fever, etc., are caused by bacteria, and that they are true processes of fermentation. The discovery that the potato-rot is caused by a fungoid plant, the muscadine of silkworms by a mould-fungus, and the pébrine of the same animal by a minute plant, and the study of the trichinæ and of several skin-diseases caused by mould-fungi have furnished a very solid foundation for this theory; but the closest analogy is to be found in the more active and rapid fermentative diseases, such as those of wine and beer, which were clearly understood by Pasteur as early as 1865.

VII. *Saccharous fermentation* is the process by which starch is changed to dextrin and glucose. This change is effected by the diastase of germinating barley and other seeds, saliva, blood-serum, pancreatic juice, etc. The starch first changes to dextrin and glucose, the former in turn changing to glucose.

$$\underset{\text{Starch.}}{2C_6H_{10}O_5} + \underset{\text{Water.}}{H_2O} = \underset{\text{Dextrin.}}{C_6H_{10}O_5} + \underset{\text{Glucose.}}{C_6H_{12}O_6}.$$

$$\underset{\text{Dextrin.}}{C_6H_{10}O_5} + \underset{\text{Water.}}{H_2O} = \underset{\text{Glucose.}}{C_6H_{12}O_6}.$$

This is one of the most important processes of nature; by it the store of starch laid up in seeds, tubers, bulbs, and in the bark of some trees, is made available for assimilation and conversion into vegetable tissue. Observations have shown it to be unconnected in any way with living organisms corresponding to yeast. See DIASTASE, GLUCOSE, DEXTRIN, BEER, GERMINATION, etc.

VIII. *Glucosic fermentation* takes place when cane-sugar is subjected to vinous fermentation.

$$\underset{\text{Cane-sugar.}}{C_{12}H_{22}O_{11}} + H_2O = \underset{\text{Lævoglucose.}}{C_6H_{12}O_6} + \underset{\text{Dextroglucose.}}{C_6H_{12}O_6}.$$

Although acids produce a similar change, it is produced by yeast, or a watery solution from yeast, in the presence of carbonate of soda. Berthollet attributes it to a nitrogenous ferment analogous to diastase or pancreatin. Béchamp (*Comp. rend.*, lviii. 601, 723; lix. 496) finds a soluble ferment in the mould of sugar solutions, which he calls *zymase*, which converts cane-sugar into glucose. See SUGAR.

IX. *Pectous Fermentation.*—Many unripe fruits and fleshy roots contain an insoluble substance called *pectose* which is converted by a ferment called *pectase* into the soluble gelatinous bodies pectin, parapectin, pectic acid, and metapectic acid. See PECTIN.

X. *Gallous Fermentation* (*Tannous Fermentation*).—When powdered nut-galls are exposed to moisture, the tannic acid they contain is changed to gallic acid with the formation of sugar; hence tannic acid has been classed with the glucosides. See GLUCOSIDES.

$$\underset{\text{Tannic acid.}}{C_{27}H_{22}O_{17}} + 4H_2O = \underset{\text{Gallic acid.}}{3C_7H_6O_5} + \underset{\text{Glucose.}}{C_6H_{12}O_6}.$$

(Stas, *Ann. Ch. Pharm.*, xxx. 205; Strecker, *ibid.*, xc. 328.) This change is said by Van Tieghem (*Compt. rend.*, lxv. 1091) to be due to the growth of the two common mould-fungi *Penicillium glaucum* and *Aspergillus niger*, but it is probably effected by various organisms. See TANNIC ACID.

XI. *Amygdalous fermentation* results from the action of the emulsin of bitter almonds upon the amygdalin, by which benzoic aldehyde, hydrocyanic acid, and glucose are produced. See ALMONDS, OIL OF.

XII. *Sinapous fermentation*, the formation of the volatile oil of mustard by the action of myrosin on myronic acid. See MUSTARD, OIL OF.

XIII. *Urinous fermentation* occurs when urine becomes putrid. The urea is changed to carbonate of ammonia by the action of bacteria.

$$\underset{\text{Urea.}}{CH_4N_2O} + 2H_2O = \underset{\text{Carbonate of ammonia.}}{(NH_4)_2CO_3}.$$

In the presence of yeast the change takes place very rapidly. (C. Schmidt, *Ann. Ch. Pharm.*, lxi. 168.) This action was very early referred to bacteria. (Pasteur, *Ann. Chim. Phys.*, 1862, 1864; Van Tieghem, *Compt. rend.*, lviii. 210, 1864.)

XIV. *Peptous fermentation* is a name given to the action of pepsin of the gastric juice on the albuminoids of the food. The exact nature of the process is not known. See PEPSIN.

XV. *Nitrification.*—It has long been known that nitrates, especially potassium and sodium nitrates, occur in the soil. Their formation in the soil has been shown to be due to the action of a living organism. The process of nitrification is therefore a kind of fermentation, if to this term be given its broadest definition. Nitrification will, however, be treated of in the article NITRIC ACID (*q. v.*).

XVI. *Soluble Ferments*, or *Enzymes.*—In addition to the changes produced by organisms, there are others of a somewhat similar character caused by unorganized bodies known as soluble ferments or enzymes. Prominent among these bodies is DIASTASE (*q. v.*). As has been pointed out, this substance has the power to convert starch into dextrin and glucose. The soluble ferments are widely distributed in nature, both in the vegetable and animal kingdoms. They fall into several groups, according to the character of the changes which they effect. These groups are: 1. *Diastatic.*—There seem to be several soluble ferments capable of causing diastatic action, or the conversion of starch into dextrin and glucose. Such substances are contained in sprouted barley, in the saliva, in the pancreatic juice, and in the secretion of the liver. 2. *Inverting Ferments.*—By the term *inversion* is meant the breaking down of certain complex sugars into simpler ones. Thus cane-sugar is broken down under the influence of a number of substances into lævulose and dextrose, and milk-sugar under similar influences yields dextrose and galactose. The ferments that cause these changes are called *inverting ferments.* They are found in the alimentary canal in animals, and, probably, in higher plants. 3. *Peptonizing Ferments.*—These "convert coagulable albuminoids into soluble and diffusible albuminoids, or *peptones.*" Among these are *pepsin*, found in the gastric juice; trypsin, found in the pancreatic juice, etc. 4. *Ferments causing the Coagulation of Casein.*—The principal ferment of this class is that contained in rennet, which is largely employed in the preparation of cheese. 5. *Ferments causing the Decomposition of Glucosides.*—An emulsion of sweet almonds contains a soluble ferment known as *emulsin*, which has the power to decompose the glucoside, amygdalin, into benzoic aldehyde, or oil of bitter almonds, glucose, and hydrocyanic acid. So also there is a similar substance, *myrosin*, which is found in the seeds of black mustard, together with potassium myronate. The ferment acting upon the latter causes the formation of glucose, allyl mustard oil, and acid potassium sulphate. 6. *Ferments causing the Conversion of Urea into Ammonium Carbonate.*—While the conversion of urea into ammonium carbonate is usually effected by means of organized ferments, it has been shown that this change can also be effected by means of an unorganized or soluble ferment.

Some of the soluble ferments are produced by the organized ferments. Thus yeast produces a substance, *invertase*, which has the power of converting cane-sugar into dextrose and lævulose.

XVII. *Prevention of Fermentation and Putrefaction.*—As moisture and the development of bacterial germs are necessary to induce these processes, they may be prevented by (1) drying thoroughly; (2) cooling to prevent the development of the germs; (3) sealing hermetically in jars or tin cans, and subjecting to a temperature sufficient to destroy the vitality of all the germs present; (4) employing antiseptic substances, such as alcohol, common salt, saltpeter, sugar, sirup, tannic acid, creosote, smoke, phenol, salicylic acid, salts of iron, zinc, lead, mercury, and copper, borax, sulphurous acid, sulphites, etc. See PRESERVATION OF FOOD, PRESERVATION OF TIMBER, and EMBALMING.

For further information on fermentation, etc., consult, in addition to the works already mentioned, F. A. P. Barnard, *The Germ Theory of Disease* (*Am. Chemist*, v. 15); Dr. J. C. Dalton, *The Origin and Propagation of Disease* (*Am. Chemist*, iv. 373) and *Spontaneous Generation* (New York *Med. J.*, Feb., 1872); A. W. Williamson, *Four Lectures on Fermentation* (*Chem. News*, xxii. 234; xxiii. 9); Dr. J. Wyman, in *Am. J. Sci.*, xliv., Sept., 1867); T. H. Huxley, *Inaug. Address* (*Chem. News*, xxii. 133) and *A Lecture on Yeast* (*Pop. Sci. Monthly*, 1872, i. p. 573); Burdon-Sanderson, *12th Rep. Med. Officer Privy Council*; A. E. Sansom, *The Antiseptic System*, and *The Germ Theory of Fermentation* (*Chem. News*, xxii. 241, 254); L. S. Beale, *Disease-Germs*; H. C. Bastian, *The Beginnings of Life*; Pasteur, *Mémoire sur la fermentation alcoolique* (*Ann. Chim. Phys.*, lviii. 1860, 323); *Animalcules infusoires vivant dans gaz oxygène libre et déterminant des fermentations* (*Compt. rend.*, 1861), and *Mémoire sur les corpuscles organisées qui existent dans l'atmosphere* (*Ann. Chim. Phys.*, 1862, p. 52); L. Engel, *Les ferments alcooliques* (Paris, 1872) and paper *On Yeast* (*Compt. rend.*, 1874, 468); Kopp, *Fermentation, history* (*Geschichte der Chem.*, iv. 285); A. Mayer, *Lehrbuch der Gährungschemie* (Heidelberg, 1874); Dr. F. A. Zürn, *Die pflanzlichen Parasiten* (Weimar, 1874); G. Hüfner, *Ungeformte Fermente* (*J. f. pr. Ch.*, 1872, Nos. 8 and 9); Weinberg, *Die Gährung* (*Bayerisches Industrie u. Gewerbeblatt*, Aug., 1870); Schwann, *Pogg. Ann.*, xli. 184; Helmholtz, *J. f. pr. Ch.*, xxxi. 429; *Handw. d. Chem.*, iii. 207; Watt's *Dictionary of Chemistry*, ii. 538; *Dictionary of Applied Chemistry*, ii. 105; A. Jörgensen, *The Micro-organisms of Fermentation* (Eng. trans. London, 1889), in which will be found a full literature, and a valuable account of the labors of Hansen and of the latest workers. Revised by IRA REMSEN.

Fermented Liquors: See BEER and WINE.

Fermoy': town; county of Cork, Ireland; 19 miles N. E. of Cork, on the right bank of the Blackwater, over which a bridge on thirteen arches was built in 1689 (see map of Ireland, ref. 13–E); is the site of St. Colman's College (Roman Catholic). The town dates from the twelfth century, when it was the seat of a magnificent abbey. Pop. 6,500.

Fern [O. Eng. *fearn*: Germ. *Farn* (in *Farnkraut*, fern); cf. Sanskr. *parna*, feather, leaf]: any plant belonging to the class *Filicinæ*. See FERNWORTS and FOSSIL PLANTS.

Fern, FANNY: See PARTON.

Fernald, JAMES CHAMPLIN: See the Appendix.

Fernandez Cordova, FRANCISCO: See CORDOVA, FRANCISCO HERNANDEZ.

Fernandez de Castro Andrade y Portugal, PEDRO ANTONIO: See CASTRO ANDRADE Y PORTUGAL.

Fernandez de Castro, dā-kaas'trō, MANUEL: geologist; b. in Madrid, Spain, Dec. 25, 1825. He graduated at the Madrid School of Mines in 1844, was sub-director of a mine at Almaden, and afterward traveled in various countries, studying railroad systems. In 1857 his work, *La electricidad y los caminos de hierro*, was published by the Government. In it he proposed a new system of railroad signals which was generally adopted. From 1859 to 1869 he was engaged in Government mining and geological work in Cuba and Santo Domingo. He made an extended report on the latter island, of which only portions were published. In 1869 he accepted a professorate at the Madrid School of Mines, and in 1873 took charge of the commission appointed to form a geological map of Spain. Under his direction a large number of geological reports and maps connected with this work have been published. In 1879 he was elected to the Spanish senate to represent Santa Clara, Cuba. Besides the works mentioned, he has published a treatise on hurricanes (1872) and many geological papers. HERBERT H. SMITH.

Fernandez de Cordova, DIEGO: Marquis of Guadalcazar; Spanish administrator of the seventeenth century. He was probably a native of Cordova, and was descended from Gonzalo de Cordoba, called "the great captain." From Oct. 18, 1612, to Mar. 14, 1621, he was Viceroy of New Spain or Mexico: beyond some trouble with corsairs on the coast, and with revolted Indians, his term was quiet. Transferred to Peru, he was viceroy there July, 1622, to Jan., 1629. The incursions of the corsairs, especially of the Dutch, had now extended to the Peruvian coasts; Jacob l'Heremite blockaded Callao for four months, and attempted to take Lima, and one of the treasure-ships was captured by Heyn; much of the coast was ravaged; the miners of the Potosi district engaged in a bloody faction war, which was brought to an end with difficulty. Returning to Spain, 1629, the marquis resided in his estate of Guadalcazar, near Cordova, and probably died there. HERBERT H. SMITH.

Fernandez de Enciso, MARTIN: See ENCISO.

Fernandez de la Cueva, FRANCISCO: Duke of Albuquerque; Spanish administrator; b. about 1610. From Aug., 1653, to May, 1661, he was Viceroy of New Spain or Mexico. His term was marked rather by lavish display and expenditure than by any real benefit to the country. The great cathedral of Mexico city was finished and dedicated during this period. On Mar. 12, 1660, the duke narrowly escaped death at the hands of an insane soldier who attacked him in his private chapel. After his return to Spain he was made Viceroy of Sicily. The date of his death is not recorded. H. H. S.

Fernandez de la Cueva Henriquez, FRANCISCO: Duke of Albuquerque; grandson of FRANCISCO; was Viceroy of New Spain Nov. 27, 1702, to Jan. 15, 1711. Like his grandfather he was greatly given to display, and his immense wealth enabled him to surpass all his predecessors in magnificence; few courts of Europe equaled that of Mexico in the pomp and show of this period. By his order various new towns were founded in the north, among others that of Albuquerque, New Mexico, so named in his honor. H. H. S.

Fernandez de Palencia, -pāā-len'thē-āā, DIEGO: soldier and author; b. in Palencia, Spain, about 1520. He went to Peru in 1545 or earlier, and served in the civil war against the rebel Giron 1553–54. The Viceroy Mendoza made him historiographer in 1556, and he began the work which was extended and finished after his return to Spain. It was finally published in Seville (1571) as *Primera y segunda parte de la historia del Peru*, including the events of the rebellions of Gonzalo Pizarro and Giron. It is one of the principal authorities for this period. D. in Seville, 1581. H. H. S.

Fernandez Madrid, JOSÉ: physician, poet, and statesman; b. at Cartagena, New Granada, Feb. 9, 1789. He studied at Bogotá, and received the degree of doctor both in law and medicine. In 1810 he joined the party of independence, was twice elected to congress from Cartagena, and on Mar. 14, 1816, accepted the difficult post of president of New Granada, succeeding Torres, who had resigned. Obliged to fly from the Spaniards, he resigned his office, and soon after was captured and sent to Havana, Cuba. There he remained for nine years, and distinguished himself as a physician and scientific author. In 1825 he returned to New Granada, and Bolivar made him minister to England. Among his published works are his poems, which have passed through several editions; two tragedies, *Atala* and *Guatimozin*; an important treatise on yellow fever; and others on medical, agricultural, and scientific subjects. D. near London, June 28, 1830. HERBERT H. SMITH.

Fernandina, fẽr-năn-dee'na: city; port of entry and capital of Nassau co., Fla. (for location of county, see map of Florida, ref. 1–J); on the west side of Amelia island, between Nassau and Prince William sounds, and separated from the mainland by a channel called Amelia river, which affords a deep, safe, and spacious anchorage. The harbor entrance is marked by a lighthouse. Vessels drawing 20 feet can enter at high tide. Fernandina ships large quantities of phosphate and lumber; it has a manufactory of superior plastering fiber from raw palmetto, extensive works for creosoting lumber and piling, sawmills, etc., and is the Atlantic terminus of the Florida Central and Peninsular Railway system, with steamships to New York, etc. Pop. (1880) 2,562; (1890) 2,803; (1900) 3,245.

EDITOR OF "FLORIDA MIRROR."

Fernando de Noronha, fer-naan'dō-dē-nō-rōn'yaa: island of Brazil; in the South Atlantic; about 260 miles E. N. E. of Cape São Roque. It is of volcanic origin, 4½ miles long from N. E. to S. W., and 1½ miles wide; the surface is much broken, the highest peak being that called the Pyramide, at the southern end. The vegetation is mainly a low forest or scrub. The climate is dry, and little of the land is available for culture; small quantities of maize, cotton, manioc, and cocoanuts are produced, and cattle, goats, and sheep are kept. A few miles N. E. of the main island there are six islets, the largest of which (Rata) is cultivated. A substance resembling guano has been found on the rocks. Fernando de Noronha was discovered in 1503 by the Portuguese navigator of that name, who called it São João. For many years it has been the site of a Brazilian penal settlement. Pop., including prisoners, over 2,000. Remedios, on the northeast coast, is the only village.

HERBERT H. SMITH.

Fernando Po: a volcanic island belonging to Spain; in the Bight of Biafra, about 20 miles from the Cameroon coast, in lat. 3° 12′ N. and lon. 3° 48′ E. It is rectangular, 44 miles by 20, with a ridge of mountains extending through it and culminating in Ste. Isabelle, 10,700 feet high. It is covered by a luxuriant forest; has a fertile soil and salubrious climate. The island was discovered in 1471 by Fernao da Pao, a Portuguese navigator, was occupied by Spain in 1778, but abandoned in 1782. It was again occupied, this time by the British, in 1827, but abandoned in 1834. The Spaniards resumed possession in 1844, and now use it as a penal settlement. The capital is Clarence Cove, a port on the northern coast. Exports, india-rubber and palm oil. The population numbers about 15,000, nine-tenths of whom are natives called Bobies, or Amigos, who are stupid, repulsive in appearance, and hostile to immigrants.

M. W. HARRINGTON.

Ferney, făr'nā': town of France; department of Ain; 4½ miles N. W. of Geneva (see map of France, ref. 6–H). It is famous as the residence of Voltaire during the last twenty years of his life (1758–78); it was a miserable hamlet when Voltaire arrived; it was a prosperous town when he left. The château in which he lived has undergone many alterations since his death, yet it retains many relics of him, and is annually visited by many thousand tourists. Pop. 1,200.

Fern Islands: See FARNE ISLANDS.

Fernow, BERNHARD EDWARD: forester; b. Jan. 7, 1851, in Inowraclaw, in the province of Posen, Prussia; studied forestry and law at the Forest Academy of Münden and University of Königsberg; entered the Government service in the forestry department; served in the Franco-Prussian war; settled in the U. S. 1876; after engaging in business without success in Brooklyn, entered on the management of timber lands in Pennsylvania 1884; in 1886 called to the head of the forestry division of the U. S. Department of Agriculture, having several years previous become secretary of the American Forestry Association and champion of the forest reform movement. Author of numerous reports, bulletins, and addresses.

C. H. T.

Fernworts: the great division of the vegetable kingdom, known otherwise as the Pteridophytes, and including the ferns proper, the horsetails, the lycopods, etc. They are related on the one hand to the mosses (Bryophytes), and on the other to the flowering plants (Anthophytes), with which they agree in the alternation of generations, the production of archegonia, and the development in one generation of a plant-body possessing a leafy stem. They are separated from the mosses by having a small and short-lived thalloid oöphore, and a large, long-lived leafy-stemmed sporophore, and from the flowering plants by the independent growth of the oöphore, and the formation of spores which separate from the sporophore. These resemblances and differences may be shown as follows:

BRYOPHYTES.	PTERIDOPHYTES.	ANTHOPHYTES.
Oöphore, a large thalloid or leafy long-lived, independent growth.	Oöphore, a small thalloid, short-lived, independent growth.	Oöphore, a small thalloid, short-lived, dependent growth.
Sporophore, small, leafless, short-lived, forming separating spores.	Sporophore, large, leafy-stemmed, long-lived, forming separating spores.	Sporophore, large leafy-stemmed, long-lived, forming spores which do not separate.

In all the ferns the germination of the spore results in the production of a small, flattish, cellular growth, usually a few millimeters or less in diameter; this is known as the prothallium (i. e. the first growth), the oöphore (i. e. the egg-cell bearer), and the sexual generation (Fig. 1, A). The second and third names refer to the fact that this growth produces the sexual organs, which consist of (1) more or less club-shaped structures (antherids, Fig. 1, B), whose inner cells develop motile spirals of protoplasm (antherozoids, Fig. 1, B, *a*), and (2) more or less flask-shaped structures (archegones, Fig. 1, C), each containing a germ-cell or egg-cell,

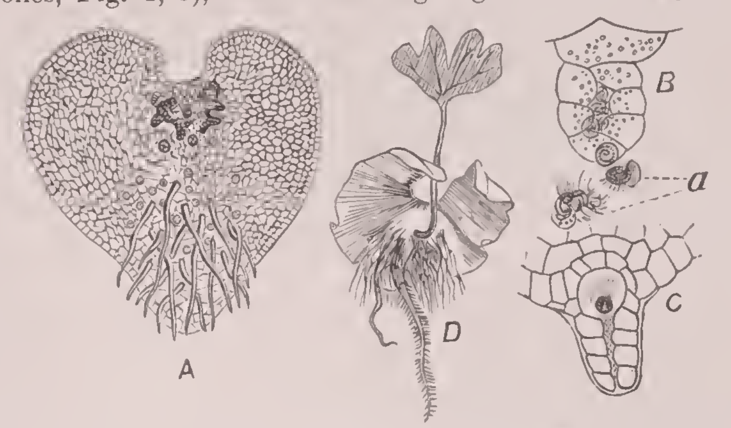


FIG. 1.—A, the prothallium (oöphore) of a fern, lower view, showing antherids mingled with the hairs, and archegones nearer the notch; B, antherid, with antherozoids (*a*) escaping; C, young archegone; D, prothallium after fertilization, with a young fern (sporophore).

called also an oösphere. When the germ-cell is mature an antherozoid fertilizes it by passing down the neck of the archegone (now open), the two masses of protoplasm fusing into one. The new cell so produced quickly undergoes division in several directions, and soon gives rise to a small shoot (with stem and leaf) and a root—the plant of the second generation (Fig. 1, D).

Throughout all the fernworts there is not much difference in the development of the sexual generation, and what has been said above of ferns is essentially true of their near allies, the horsetails and lycopods. The asexual generation, however, which develops from the fertilized egg-cell shows marked structural differences, and it is upon these that the

FIG. 2.—Asexual plants (sporophores): A, *Notholœna*; B, *Scolopendrium*.

classification of the fernworts is based. In all cases there is a high development of the internal tissues of root, stem, and leaf, while in their external conformation the leaves usually attain a high degree of complexity. Upon (or in) some of the leaves certain cells divide and give rise (asexually) to thick-walled cells which separate from the parent plant as spores (Fig. 3, B). In the details of the spore-formation, again, there are many differences, and these are used in the separation of orders, families, and genera.

The living fernworts now known number about 4,000 species, and possibly, when all parts of the world are thoroughly explored, this may approach close to 5,000. If to the living fernworts there could be added the vast number of extinct species, which extend a measureless distance back in geologic time, doubtless the number would be swelled to many times that given above. As it is, although fossil fragments are very abundant, the definitely known species do not number above 1,000. The living species are widely distributed, being most abundant in the hot, moist regions, and least

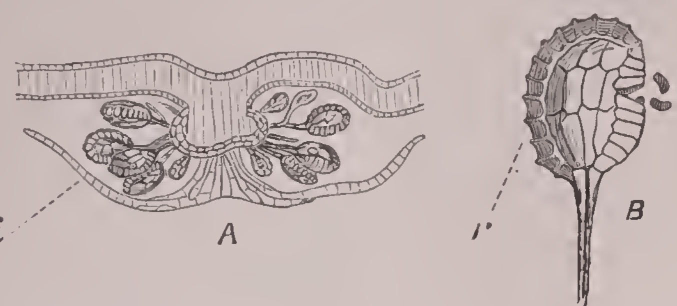


Fig. 3.—A, cross-section of a leaf through a sorus, showing the sporangia, and the indusium (*i*); B, a sporangium splitting open, *r*, its ring of thick-walled cells.

abundant in dry climates. In North America there are about 250 species and well-marked varieties, three-fourths of which are ferns proper.

The fernworts are usually separated into three classes, although investigations by Campbell render it probable that this number must be increased. The sequence of the orders is likewise in doubt, as shown by Campbell's studies. The following synopsis is therefore provisional:

Class I. Filicinæ.—The ferns. Stems solid, leaves usually large, with broadly expanded blade, and elongated petioles.

Order 1. *Ophioglossaceæ*, spores developed from cells in the tissue of the leaf; leaves erect in the bud (not circinate).

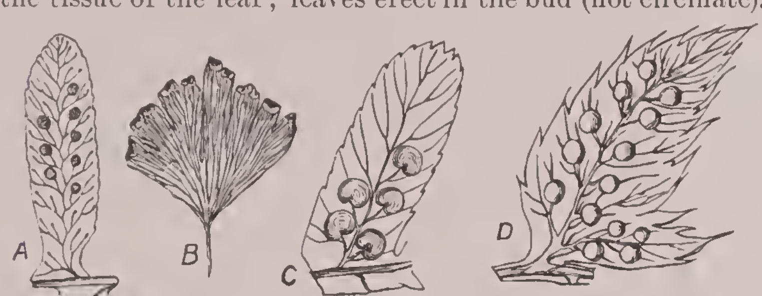


Fig. 4.—Parts of spore-bearing leaves, showing sori: A, *Polypodium*; B, *Adiantum*; C and D, *Aspidium*.

Family 1. *Ophioglosseæ*, the adder-tongues, with the characters of the order. There are several species of *Botrychium* and *Ophioglossum* in the U. S.

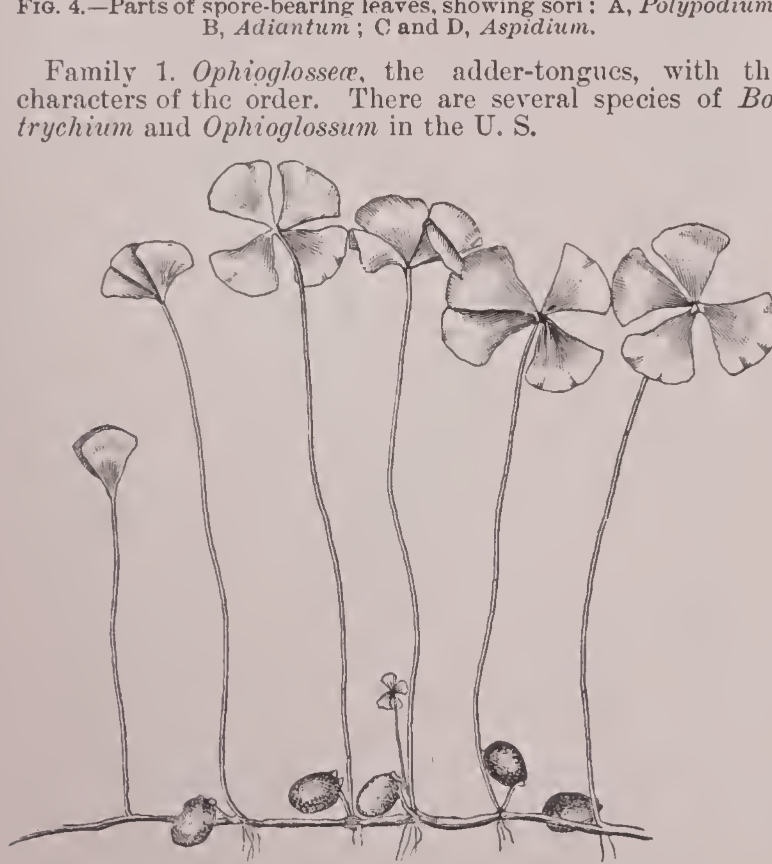


Fig. 5.—*Marsilia vestita*, of America, slightly reduced.

Order 2. *Marattiaceæ*, the ringless ferns; spores developed in external cell-masses (*sporangia*) which originate as massive outgrowths by the division of internal cells beneath the lower surface of the leaves: leaves circinate in the bud.

Family 2. *Angiopterideæ*, with a single surviving genus, *Angiopteris*, containing one variable tree-like species of Southeast Asia, Australia, and Madagascar.

Family 3. *Marattieæ*, with two genera, *Marattia* and *Kaulfussia*, of the tropics of both hemispheres, some of the species tree-like.

Family 4. *Danæaceæ*, with but a single genus—*Danæa*—of about a dozen species of smaller ferns of tropical America.

Order 3. *Filices*, the true ferns; spores developed from cells in specially modified hairs (*sporangia*), usually on the under surface of the leaf and collected in clusters (*sori*); leaves circinate in the bud.

Family 5. *Osmundaceæ*, with globose sporangia which have only a trace of a horizontal belt of thick-walled cells, and split open vertically. Three of the six species of *Osmunda* occur in North America; *Todea* with four species (one tree-like) is almost confined to the south temperate zone.

Fig. 6.—*Pilularia globulifera*, of Europe.

Family 6. *Gleicheniaceæ*, with globose sporangia which have a horizontal belt (ring) of thick-walled cells, splitting vertically. *Platyzoma* of Australia and *Gleichenia* of the hot regions of both hemispheres are represented by about thirty species of small or slender ferns.

Family 7. *Schizæaceæ*, with ovate or sub-globose sporangia, which have a terminal belt of thick-walled cells, splitting vertically. *Lygodium*, the climbing ferns of many species, represented by *L. palmatum* in Eastern U. S.; *Schizæa* mostly of the tropics (one of U. S.); *Anemia* of tropical America (two species in Southern U. S.); and *Mohria* of Africa are the principal genera.

Family 8. *Hymenophyllaceæ*, with compressed sporangia which have a horizontal or oblique belt of thick-walled cells, splitting vertically. The leaves are mostly composed of but a single layer of cells, and the sori are marginal, the sporangia developing on a prolongation of a vein. *Hymenophyllum* and *Trichomanes* (two species in Southern U. S.), the principal genera, include 150 or more species of delicate ferns, mostly of warm climates.

Family 9. *Cyatheaceæ* (tree-ferns), with compressed sporangia which have a vertical or sub-oblique belt of thick-walled cells, splitting transversely. Sori often covered or surrounded by an involucre (*indusium*). Mostly large tropical ferns with erect stems. *Alsophila*, *Hemitelia*, *Cyathea*, and *Matonia* are the principal genera, some species of which reach 40 to 50 or more feet in height.

Family 10. *Polypodiaceæ*, with compressed, stalked sporangia, which have a vertical incomplete belt of thick-walled cells, splitting transversely. Sori often covered or surrounded by an involucre (*indusium*). This is by far the largest family of living ferns, and includes nearly all the common species of the U. S. The principal genera are *Acrostichum*, *Adiantum* (Fig. 4, B), *Asplenium*, *Aspidium* (Fig. 4, C, D), *Blechnum*, *Cheilanthes*, *Camptosorus*, *Cystopteris*, *Dicksonia*, *Gymnogramme*, *Notholæna* (Fig. 2, A), *Onoclea*, *Polypodium* (Fig. 4, A), *Pteris*, *Pellæa*, *Phegopteris*, *Scolopendrium* (Fig. 2, B), *Woodwardia*, and *Woodsia*.

Fig. 7. — Fruiting branches of *Equisetum arvense*, with a detached spore-bearing leaf enlarged at *a*.

Order 4. *Hydropterideæ*, the water-ferns; spores of two kinds, developed from cells in specially modified hairs (sporangia), these inclosed in "sporocarps" which are much modified leaves. The smaller spores (microspores) in germination develop minute prothallia, bearing antherids only, while the larger spores (macrospores) develop prothallia bearing archegones only. The sexual plants (oöphores) are therefore diœcious.

FIG. 8.—Terminal portion of *Lycopodium annotinum*, spore-bearing leaves above.

Family 11. *Salviniaceæ*, small floating plants of two genera, *Salvinia* (twelve species, one in U. S.) and *Azolla* (five almost microscopic species, two in U. S.).

Family 12. *Marsiliaceæ*, creeping semi-aquatic or aquatic plants, rooting in the mud, and bearing filiform or four-parted leaves. The two genera, *Marsilia* (Fig. 5) and *Pilularia* (Fig. 6), include respectively forty, and six species widely distributed. Four or five species of *Marsilia* and one of *Pilularia* occur in North America.

CLASS II. EQUISETINÆ.—The horsetails. Stems hollow, jointed, the joints solid; leaves rudimentary and whorled.

Order 5. *Equisetaceæ*, with sporangia on the under surface of the whorls of peltate leaves at the summit of the stem.

Family 13. *Equisetaceæ*, including twenty widely distributed species, all of the genus *Equisetum*; thirteen species occur in North America.

CLASS III. LYCOPODINÆ.—The lycopods. Stems solid, dichotomously branched, leaves small and narrow, scattered. Probably an unnatural group.

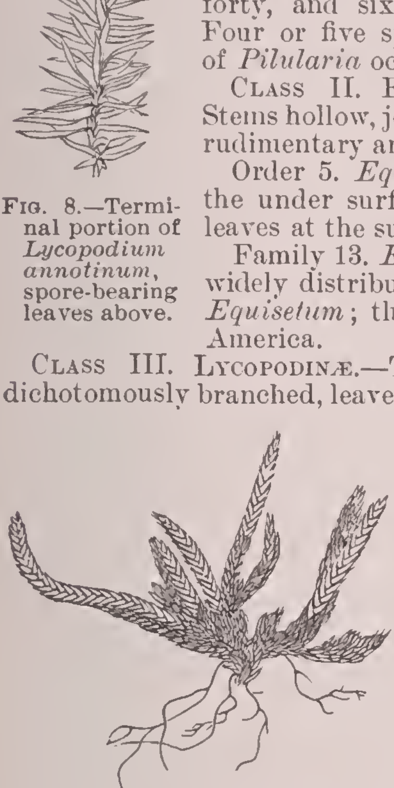


FIG. 9.—*Selaginella rupestris*, fruiting specimen, natural size.

Order 6. *Lycopodiaceæ*, the club-mosses. Sporangia single in the axils of the small upper leaves, spores all alike.

Family 14. *Lycopodiaceæ*, small evergreen perennial plants. There are four genera, *Lycopodium* (with ninety-four species, twelve in U. S.), *Psilotum* (two species, one in U. S.), *Phylloglossum*, and *Tmesipteris*.

Order 7. *Selaginellaceæ*. The little club-mosses. Sporangia single in the axils of the small upper leaves; spores of two kinds, viz., macrospores and microspores.

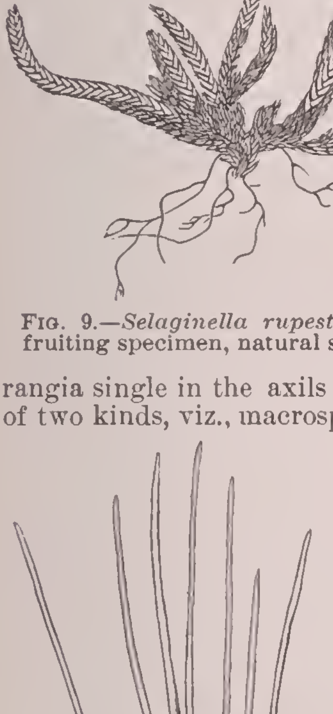


FIG. 10.—*Isoetes melanopoda*, of the Mississippi valley, slightly reduced.

Family 15. *Selaginelleæ*, contains the single genus *Selaginella* (334 species, mostly tropical, eight in U. S.), of small evergreen perennial plants.

Order 8. *Isoetaceæ*, the quillworts. Very short-stemmed plants; sporangia in the axils of the narrow, rush-like leaves; spores of two kinds, viz., macrospores and microspores.

Family 16. *Isoetaceæ*, aquatic or semi-aquatic plants of a single genus, *Isoetes*, containing forty-nine species, seventeen of which occur in North America.

Of the economic uses of fernworts little need be said. Pulu, used for stuffing pillows and cushions, is obtained from the woolly-hairy covering of the young leaves of a Sandwich island species of *Dicksonia*. The stems of a few species contain enough starchy matter to make them useful for food in some parts of the world, e. g. *Pteris aquilina* in Australia, and *Cyathea medullaris* on the Pacific islands. A few species are of doubtful value as astringent medicines. One species of horsetail (*Equisetum hyemale*) is the "scouring-rush," much used in Europe for polishing cutlery. *Lycopodium* furnishes the "lycopodium powder" of the shops. Many fernworts are in use for ornamental purposes, many ferns especially being grown in greenhouses and conservatories.

LITERATURE.—The reader is referred to the following works: K. Goebel, *Outlines of Classification and Special Morphology of Plants* (1887); Chr. Luerssen, *Handbuch der Systematischen Botanik* (vol. i., 1879); A. De Bary, *Comparative Anatomy of the Vegetative Organs of the Phanerogams and Ferns* (1884); W. J. Hooker and J. G. Baker, *Synopsis Filicum, or a Synopsis of all Known Ferns* (2d ed. 1883); J. G. Baker, *Handbook of the Fern Allies* (1887); D. C. Eaton, *The Ferns of North America* (2 vols., 1879–80); L. M. Underwood, *Our Native Ferns and their Allies* (1888). Also various papers by D. H. Campbell: *The Development of the Ostrich Fern* (*Mem. Bos. Soc. Nat. Hist.* 1887); *The Development of Pilularia globulifera* (*An. Bot.* 1888); *Development of the Prothallium and Embryo of Osmunda* (*An. Bot.* 1892); *The Affinities of the Filicinæ* (*Bot. Gaz.* 1890); *On the Relationships of the Archegoniata* (*Bot. Gaz.* 1891).

CHARLES E. BESSEY.

Fero′nia: an Italian goddess concerning whose cultus and myth little is known. She has been variously regarded as goddess of the earth, of the inferior world, of commerce, and of liberty. She appears to have been especially honored among the Sabines; and the chief seat of her worship was the town of Feronia, at the foot of Mt. Soracte.

Ferozepore: See FIROZPUR.

Ferrand, JOSEPH: See the Appendix.

Ferrand, MARIE LOUIS, Baron and Count of: soldier; b. at Besançon, France, Oct. 12, 1753. He served as a volunteer in the North American war for independence, and after 1790 distinguished himself in the French army of the West. In 1802 he commanded under Leclerc in the Santo Domingo expedition. After Leclerc's death (Nov. 1, 1802) and the capitulation of Rochambeau, Gen. Ferrand retreated to Santo Domingo city, where he withstood a siege by Dessalines (Mar., 1804), and was finally left in possession of the eastern or Spanish part of the island; here he resisted the advance of the revolutionists for several years, and was named captain-general by Bonaparte. The war between France and Spain led to the invasion of Santo Domingo by a Spanish force under the governor of Porto Rico; Ferrand was defeated at Palo Fincado, and shot himself on the battle-field Nov. 7, 1808. HERBERT H. SMITH.

Ferrar, NICHOLAS: religious enthusiast; b. in London, England, 1592; studied at Clare Hall, Cambridge, and took the degree of B. A. 1610; early manifested intense religious feeling, and pursued his studies with such diligence as to impair his health and necessitate a period of rest and foreign travel 1613–18. On his return to England he entered his father's business, that of a merchant in high standing in London and closely connected with the interests of the Virginia Company. Ferrar was prominent in the affairs of that company and active in opposing the attempts of the council to override the charter. He was elected to Parliament in 1624, but soon gave up public life to found the religious community at Little Gidding, in Huntingdonshire, with which his name is identified. With his wife and relatives, numbering some thirty persons, he passed a life of strict religious discipline, acting as chaplain for the little community. The observance of all the rules and exercises of the Church, including the attendance at worship twice daily, and nightly watches and prayers, brought upon the community the unfavorable comments of the Puritans, who characterized it as a "Protestant nunnery." All members of the society were required to learn a trade, and that of bookbinding was practiced. Ferrar died Dec. 4, 1637. He left some religious writings, among which are a harmony of the Gospels and translations of the *Divine Considerations* of Valdez and Lessio *On Temperance*. The establishment of Little Gidding suffered in the civil war. It was visited by Charles I. in 1642, but in 1647 the house and church fell into the hands of the Parliamentarians and the community was broken up. See Mayor, *Nicholas Ferrar, Two Lives* (Cambridge, 1855). F. M. COLBY.

Ferrara, fer-raa′raă: province of Italy; bounded N. by the main branch of the Po, E. by the Adriatic, S. and W. by the provinces of Ravenna, Bologna, and Modena. Area, 1,144 sq. miles. The ground is low, in many parts below the level of the Po, marshy, and unhealthful, but the soil is rich, and produces grain, flax, and hemp; there are also extensive pastures. In the Middle Ages Ferrara formed a dukedom belonging to the house of Este. In 1598 Clement VIII. united it to the Papal States. In 1860 it became a part of the kingdom of Italy. Pop. (1890) 250,430.

Ferrara: a fortified city of Northern Italy; capital of the province of the same name; 29 miles by rail N. E. of Bologna (see map of Italy, ref. 3–D). While this province belonged to the house of Este, Ferrara was the ducal residence and a city of great splendor and importance. It was a commercial center in Northern Italy; it developed a school of art of its own; Tasso, Ariosto, and Guarino lived here. Under the papal rule it went into decay, and it has now a somewhat deserted and melancholy appearance. The cathedral, the ducal palace, etc., with their collections of pictures, are of great interest. The university, founded in 1264, has an excellent library of 100,000 volumes. Ferrara is an archbishop's see. Pop. 28,814; commune, 86,000.

Ferrara, Council of: an ecclesiastical council whose sixteen sessions were in continuation of the Council of Basel, and which began on Jan. 8, 1438. In March of that year it was visited by the Byzantine emperor, John Palæologus, with 700 followers, including the Patriarch of Constantinople, the emperor hoping, by obtaining a union of the Eastern and Latin Churches, to gain the aid of the West against the Turks. On Apr. 9, 1438, the council was opened as a union council of the two Churches, and discussed principally their points of difference. In Jan., 1439, the council was transferred to Florence. See FLORENCE, COUNCIL OF.
Revised by S. M. JACKSON.

Ferrari, -raa'rēē, GAUDENZIO: painter; b. at Valduggia, in Piedmont, in 1484. His artistic training began under Girolamo Giovannone, and afterward at Milan he studied with Scotto, and as some assert with Bernardino Luini. He then went to Rome, attracted by the fame of Raphael, who received him as a colleague, and with whom he worked till he was recalled to his own country to execute important commissions in 1514. Lomazzo considers Ferrari as one of the seven principal painters the world ever had. His chief work is the *Crucifixion*, in a chapel of the sanctuary of Varallo. At Milan he painted the *Passion of Our Lord*, in the church of the Grazie, and *St. Paul in Meditation*. These two pictures were taken to Paris in 1797. Milan, Vercelli, Saronno, and other cities of Lombardy contain many of his works. He had a flourishing school of painters, who imitated him. D. in 1550. W. J. STILLMAN.

Ferrari, GIUSEPPE: philosopher and historian; b. in Milan in 1811; studied law at Pavia, but devoted himself subsequently to literature; published in 1835 a complete edition of the works of Vico; went in 1837 to Paris, where in 1839 he published *Vico et l'Italie*; was appointed Professor of Philosophy in 1840 at Rochefort, and afterward at Strassburg, but was removed on account of his communistic ideas; published in 1847 *Essai sur le Principe et les Limites de la Philosophie de l'Histoire*; was reinstated in his chair in Strassburg in 1848, but again removed, and returned in 1859 to Italy, where he was successively made professor in Turin, Milan, and Florence. Of his numerous works, the most remarkable are *Filosofia della Rivoluzione* (1851); *Histoire des Révolutions d'Italie* (4 vols., 1856–58); *Corso di Lezioni sugli Scrittori Politici Italiani* (1862–63). D. July 1, 1876.

Ferrari, PAOLO: dramatist; b. in Modena, Italy, 1822. His first comedy, *Bartolommeo il Calzalajo*, was produced in 1847. In 1852 he wrote his masterpiece, *Goldoni e le sue sedici commedie*, which was followed by *Parini e la Satira* (1857). Both these works are among the best of modern Italian comedies. A collection of his *Opere drammatiche* was published in Milan in 1877–80. He was made Professor of History at Modena in 1860, and later in the academy at Milan. D. in Milan, Mar. 10, 1889.

Ferraris, GALILEO: See the Appendix.

Ferreira, ANTONIO: poet; b. at Lisbon, Portugal, 1528; studied law at Coimbra, but took more interest in literature, and especially the works of the classic poets, whom he strove to imitate in the Portuguese tongue. With his model, Sá de Miranda, he was the founder of the patriotic classical school of Portuguese poetry. He is the author of many sonnets, odes, epigrams, and a tragedy of Inez de Castro; but the best of his works are probably his epistles. D. of the plague in 1569. Nothing of his was printed in his lifetime, but his son Miguel published a collection of his poems under the title *Poemas lusitanos* in 1598.

Ferrer, RAFAEL: Spanish Jesuit missionary; b. in Valencia, 1570. He was sent to Peru, was one of the founders of the Jesuit convent at Quito 1593, and subsequently labored among the Yumbos Indians. In 1601 he penetrated to the territory of the savage Cofanis, in the forest E. of the Andes, and established them in mission villages. From 1605 to 1607 he was employed, by order of the Viceroy of Peru, in exploring the Napo. Returning to his Cofani missions, he was murdered at San José by an Indian whom he had forced to renounce polygamy (1611). H. H. S.

Ferret [from O. Fr. *furet* < Mediæv. Lat. *furetus*, dimin. of *furo*, ferret; deriv. of Lat. *fur*, thief, because of its craftiness]: a carnivorous mammal (*Putorius furo*) of the weasel family, so closely allied to the European polecat (*Putorius fœtidus*) that many regard it as merely a delicate albino variety of the latter. It breeds freely with the polecat, has red eyes, a white or yellowish fur, and is so tender that the winters of England are too severe for it unless it is well housed. It is half-domesticated in Europe, but is probably of African origin. It is much employed in hunting rabbits and rats, but often has to be muzzled, as otherwise it will suck its victim's blood and leave the body in the burrow. It is fierce and treacherous, sometimes severely biting the hand of its master.

Ferric Oxide: See IRON.

Ferricy'anides [Mod. Lat. *ferri-*, a compounding form of *ferrum*, iron + Eng. *cyanide*. See CYANIDE]: a class of chemical compounds formed by the action of oxidizing agents upon ferrocyanides, from which an atom of the metal is extracted. For example, the potassium ferrocyanide (yellow prussiate of potash, $4KCy.FeCy_2$) is changed by the action of chlorine into potassium ferricyanide (red prussiate of potash, $6KCy.Fe_2Cy_6$). The most important of these salts are the potassio-ferrous ferricyanide (soluble Prussian blue) and Turnbull's blue (ferrous ferricyanide). Potassium ferricyanide is a delicate test for ferrous salts, and is invaluable in the laboratory. The ferricyanides may be regarded as compounds of ferric cyanide (Fe_2Cy_6) with some other cyanide.

Ferrier, fer'ri-er, DAVID, M. D., LL. D., F. R. S., F. R. C. P.: neurologist; b. at Aberdeen, Scotland, in 1843; educated at the University of Aberdeen, graduating as master of arts in 1863, with double first-class honors in classics and philosophy. In the same year he gained the Ferguson scholarship in classics and philosophy, open for competition to graduates of the four Scotch universities. In 1854 he entered the University of Heidelberg, where he prosecuted psychological studies and began the study of anatomy, physiology, and chemistry; in 1865 he began his medical studies proper at the University of Edinburgh, where he gained most of the university medals in his various classes, and where he graduated M. B. in 1868, with first-class honors. He continued at the university as assistant to Dr. Laycock, Professor of the Practice of Physic, until 1869, when he became assistant to a practitioner at Bury St. Edmunds, where he remained for a year, meanwhile prosecuting his researches on the comparative anatomy and histology of the brain. In 1868 he received his M. D. degree, and was awarded the gold medal for his thesis, *Comparative Anatomy of the Corpora Quadrigemina*. In the same year Dr. Ferrier removed to London, and in 1871 was appointed Demonstrator of Physiology in King's College. In 1872 he was appointed Professor of Forensic Medicine in the same institution, succeeding Dr. Grey, whom he aided in the preparation of the fourth and fifth editions of his *Principles of Forensic Medicine*. This position he retained until 1889. He was appointed junior physician to the West London Hospital in 1872, assistant physician to King's College Hospital in 1874, and full physician in 1880. He was assistant physician to the Hospital for Epilepsy and Paralysis, Regent's Park, from 1877 till 1880, when he was appointed physician to the National Hospital for the Paralyzed and Epileptic. Besides numerous papers on questions touching cerebro-spinal disease, Dr. Ferrier has published *The Functions of the Brain* (1876 and 1884) and *The Localization of Cerebral Disease* (Gulstonian Lectures, 1878). He was one of the founders and remains an editor of *Brain: a Journal of Neurology*.

Ferrier, JAMES FREDERICK: moral philosopher; b. in Edinburgh, Scotland, June 16, 1808; son-in-law and nephew of Prof. John Wilson; graduated at Magdalen College, Oxford, in 1831; became Professor of History at Edinburgh University in 1842, and of Moral Philosophy and Political

Economy at St. Andrews in 1845. *Institutes of Metaphysic, the Theory of Knowing and Being*, was his chief work, though he edited the *Works* of his father-in-law in 12 vols. Ferrier died at St. Andrews, June 11, 1864. His *Lectures on Greek Philosophy*, with a *Life* prefixed, were published in 1866.

Ferrier, fā'ri-ā', Joseph Marie Augustin Gabriel: figure and portrait painter; b. at Nîmes, France, Sept. 29, 1847. Pupil of Lecocq de Boisbaudran; Grand Prix de Rome 1872; first-class medals, Paris Expositions, 1878 and 1889; Legion of Honor 1884. A strong draughtsman whose work is solid and vigorous. *David, Conqueror of Goliath*, Nîmes Museum; *St. Agnes, Martyr*, Rouen Museum, are among his works. Studio in Paris. W. A. C.

Ferris, Isaac, D. D., LL. D.: clergyman; b. in New York, Oct. 9, 1798; graduated at Columbia College in 1816, having served for a time during his college course in a military company during the war of 1812; taught in the Albany Academy for one year; studied theology under Dr. J. M. Mason two years, and in the Rutgers Seminary at New Brunswick, N. J., one year; was licensed to preach in 1820; held Reformed Dutch pastorates at New Brunswick, N. J., 1821–24; at Albany, N. Y., 1824–36; in the Market Street church, New York, 1836–53; chancellor of the University of New York city 1852–70. He found the university in a depressed state, and largely by his own personal efforts brought it to a condition of prosperity. He was Professor of Moral Science and Christian Evidences 1853–70, and acting Professor of Constitutional and International Law 1855–69. Previous to his chancellorship he was for a time principal of the Rutgers Institute for young women. D. at Roselle, N. J., June 16, 1873.

Fer'ro: the smallest and least fertile of the Canary islands; situated in lat. 27° 45' N. and lon. 18° 7' W.; area, 106 sq. miles. As it is the most westerly isle of the archipelago, it was by ancient geographers considered the most westerly point of the world, and they drew through it the first meridian, which is still used as the prime meridian on maps designed to show all of Europe in the eastern hemisphere. Pop. (1887) 5,892.

Ferrocy'anides [Mod. Lat. *ferro-*, a compounding form of *ferrum*, iron + *cyanide*]: a class of chemical compounds formed by uniting ferrous cyanide with some other cyanide. Thus ferrous cyanide ($FeCy_2$), added to four equivalents of potassium cyanide (KCy), gives $K_4Fe''Cy_6 = 4KCy.Fe''Cy_2 =$ the ferrocyanide of potassium (yellow prussiate of potash), an extremely valuable chemical reagent; useful also in pharmacy, and especially in dyeing and calico-printing. Refuse animal matters, iron-filings, and commercial potash are melted together, and the mass is poured into hot water, filtered, evaporated, and repeatedly crystallized, yielding a very pure salt; but several other processes have been invented. Ferric ferrocyanide is commercial Prussian blue.

Fer'rol: a strongly fortified seaport of Spain; province of Corunna; 11 miles N. E. of Corunna (see map of Spain, ref. 11–B). Its harbor, surrounded by splendid dockyards, is formed by an inlet of the Bay of Betanzos, so narrow as to admit only one ship of the line at a time, and defended by the castles of San Felipe and Palma. Ferrol is one of the chief naval arsenals of Spain, and has sardine-fisheries and manufactures of naval stores, cotton, and leather. Pop. (1887) 25,701.

Ferrotype: See Photography.

Ferry (Fr. pron. fā'ree'), Jules François Camille: advocate, journalist, and statesman; b. at St.-Dié, France, Apr. 5, 1832; was admitted to the Paris bar in 1851 and became connected with the *Gazette des Tribunaux*. In 1865 he contributed to the *Temps*, obtaining notoriety in 1868 by his attacks on Baron Hausmann's administration of Paris. In 1869 he was returned to the Corps Législatif from Paris, and in Sept., 1870, became a member of the government of the national defense; Minister of Public Instruction and Fine Arts 1879–80 and 1882; president of the council 1880–81; Prime Minister and Minister of Public Instruction 1883–85. In 1880 he caused a great excitement in France by a paragraph of his education bill, which forbade members of the unauthorized orders (Jesuits) to teach in the schools. The paragraph was rejected by the senate, but the minister succeeded by enforcing some old laws long fallen into oblivion. However, this led to the downfall of the ministry. He formed another cabinet, and remained Prime Minister until 1881, but was forced to resign on the Tunis question. In 1883 he again became Prime Minister; the result of his colonial policy led to the war in Tonquin, the unsatisfactory issue of which culminated in the overthrow of M. Ferry in 1884. He retired one of the most unpopular men in France. In 1887 he was an unsuccessful candidate for the presidency, and just after the election he was shot by Aubertin. He retired from public life for a time, but was re-elected to the chamber in Dec., 1890, and was soon after made senator. Feb. 25, 1893, he was elected president of the French senate. He was the most distinguished of the few great men in France who were not involved in the least in the Panama scandal, and he was regarded as almost certain to succeed to the presidency of the republic on the retirement of M. Carnot. He died Mar. 17, 1893, from the effects of the wound received in 1887. He was one of the most brilliant of French journalists, and one of the strongest leaders in French political life. His rise to power again after the disaster that befell his fortunes in 1884 has few parallels. Revised by C. H. Thurber.

Ferry, fer'ri, Orris Sanford: U. S. Senator; b. in Bethel, Conn., Aug. 15, 1823; graduated at Yale College in 1844, and was admitted to the bar in 1846; in 1847 was lieutenant-colonel of the first division of Connecticut militia; in 1849 judge of probate for the district of Norwalk, Conn.; State Senator in 1855 and 1856; in 1856–59 State attorney for the county of Fairfield; in 1859 was chosen Representative to Congress from Connecticut. Served as colonel and brigadier-general in the U. S. volunteers in the war of 1860–65, and was then chosen U. S. Senator from Connecticut for 1867–73. In 1872 he was re-elected to the same office for a second term. D. at Norwalk, Conn., Nov. 21, 1875.

Ferry (Fr. pron. fā'ree'), Paul: a French Protestant divine, noted for his irenic proclivities. He was born at Metz, Feb. 24, 1591; his mother was sister to Attorney-General Jolly. Paul was destined for the ministry, and educated at the Huguenot seminary in Montauban, where, while yet a student, he issued a volume of poems of considerable merit. In 1612 he took holy orders, and returned to his native place to become pastor of a congregation which he served until his death July 28, 1669. Ferry was distinguished for his eloquence, and ranked second only to Calmet in all Lorraine. He was not only the pride of Protestants, but was beloved also by Roman Catholics, and gave himself so largely to efforts not only for a union of all Protestants, but of all Christians, that he was surnamed The Pacificator. He corresponded for this purpose with the great Scotch irenic, John Dury, and with the noted French ecclesiastic Bossuet. (See *Œuvres de Bossuet*, Versailles ed., vol. xxv.) The correspondence with Bossuet was provoked by Ferry's *Catéchisme Général de la Réformation* (Sedan, 1654), which, holding that the corruption of the Church had called for the Reformation, was replied to by Bossuet, and thus opened the way for an exchange of opinions on many topics, until the irenical subject became uppermost. Ferry is charged with having received a pension of 500 crowns from the Government, under Richelieu, for agitating the reunion of Roman Catholics and Protestants in France. His receipt for the amount is said to exist in the National Library at Paris. Ferry wrote much, but published little. His most important works are *Scholastici Orthodoxi Specimen* (Geneva, 1616); *Le dernier désespoir de la tradition contre l'écriture* (Sedan, 1618; defended against attacks in 1624); *Vindiciæ pro Scholastico orthodoxo adversus Leon. Perinium Jesuit.* (Leyden, 1630). See Haag, *La France Protestante.*

Ferry, fer'ri, Thomas White: U. S. Senator; b. at Mackinaw, Mich., June 1, 1827; entered early upon a business life; removed to Grand Haven; sent to the State Legislature in 1850, to the State Senate in 1856; long an active member of the State Republican committee; a vice-president of the Chicago convention of 1860; member of Congress 1864–71; U. S. Senator 1871–83; chosen president *pro tem.* of the Senate; became acting Vice-President of the U. S. on the death of Henry Wilson, Nov. 22, 1875; was reelected to the Senate Jan. 17, 1877, and was several times elected president *pro tem.* of the Senate. After his term expired in 1883 he spent several years in foreign travel. D. at Grand Haven, Mich., Oct. 14, 1896.

Ferryland: port of entry of Newfoundland and the capital of Ferryland district; 44 miles S. of St. John's. It was settled by Lord Baltimore in 1623, and called Avalon; was deserted in consequence of disturbances by the French. Ruins of the old batteries remain. It has a good harbor and a lighthouse. Pop. 680.

Fertilization of Plants: the process by which the contents of two sexual cells are blended to form the starting-point in a new development. In flowering as well as flowerless plants the mechanism of reproduction is so complicated that some knowledge of vegetable physiology is necessary to its comprehension. See FLOWER and PHYSIOLOGY, VEGETABLE.

Fertilizers [from Lat. *ferti'lis*, fertile, deriv. of *ferre*, bear]: substances which enrich the soil and promote the growth of plants. Agriculturists distinguish usually between home-made and artificial mineral or commercial fertilizers. The former consist mainly of the various refuse matters, animal and vegetable, incidental to the particular farm operations carried on. The latter include a large number of articles which are obtained elsewhere than from the farm. The use of animal secretions of every description, and of all kinds of vegetable refuse matter in the form of barnyard manure and farm composts, has been known in agriculture from time immemorial, while the application of the commercial fertilizers can scarcely be dated further back than to the close of the eighteenth or the beginning of the nineteenth century. Lime, salt, saltpeter, oyster-shells, gypsum, and ground bones are among the first more prominently mentioned commercial fertilizing substances. The consumption, however, of these and similar articles remained quite limited until Prof. Justus von Liebig made his famous exposition of the relations which exist between the constituents of the soil and the growth of plants.

The extensive use of commercial or artificial fertilizers is one of the most important features in the present management of farms. Their merits are so generally recognized that a rational and thorough system of agriculture is thought impracticable without their assistance, particularly when it is proposed to apply them for the purpose of rendering the stable manure a complete fertilizer for the various crops under cultivation. The successful introduction of these fertilizers furnishes one of the most striking illustrations of the influence and the value which exact modes of inquiry with well-defined questions have over mere experimenting without a previous correct appreciation of the agencies and the principles involved in the operation.

Agriculture, although one of the oldest industries, was, comparatively speaking, long deficient in rational explanations of many of its modes of operation. Stable manure, ashes of plants, and various other means, as fallow and rotation of crops, irrigation, and drainage, etc., had been employed for ages in the interest of a successful fertilization of cultivated lands, yet no satisfactory explanation regarding their respective action was offered until quite recently —a fact which readily accounts for their repeated failures in former ages. The state of the natural and the physical sciences previous to the beginning of the nineteenth century rendered in many instances a correct exposition of the processes involved impossible. To enter with any reasonable prospect of success upon the discussion of so intricate questions as the relation of animal secretions to plant-life required not only a familiarity with the composition of the air, the water, and the soil, and the various reactions of these agencies upon each other and on plant-life under the influence of light and heat, but also a thorough knowledge of the various constituents of plants and animals, their respective organizations, and the functions of their assimilative, respiratory, and excretory organs. Without any knowledge of the nature of the previously mentioned important physiological processes peculiar to animal and vegetable life, not even an approximately correct appreciation could be entertained regarding the mutual dependency of plants and animals in the economy of farming. Modern agriculture rests its claim of real progress, as compared with previous centuries, less on the introduction of new means for the maintenance of an increased production of cultivated lands than on a more efficient because more rational use of the best features of well-known modes of cultivation. It ascribes the present advanced position, and its claims of being a scientific art, to the accumulated results of the scientific researches of many of the most illustrious scientists of the eighteenth century in every branch of the natural and physical sciences, and recognizes in Lavoisier, Sir Humphry Davy, and Liebig the foremost and most influential minds during its various stages of progress. One of the most important services which the experimental sciences have rendered to practical agriculture consists in the elucidation of the fact that it is essential to a successful cultivation of the various crops to restore without delay to the soil those of its constituents which the crops have abstracted.

Not long before the middle of the nineteenth century the mineral constituents of plants were looked upon as being merely of incidental occurrence, and without any essential bearing upon their development: these views have been entirely changed in consequence of careful analytical investigations. In comparing the ash-constituents of different plants it was noticed soon that certain mineral elements were present in a more or less conspicuous proportion in every plant. The general occurrence of these substances led ultimately to the quite natural assumption that their presence might be necessary for the performance of some physiological process of vegetable life. These important relations were in their general outlines for the first time pointed out in the year 1840 by Justus von Liebig in his work on *Organic Chemistry in its Application to Agriculture and Physiology*. Subsequent additional actual experiments, instituted under well-defined circumstances for testing his views, not only confirmed their correctness in their main features, but furnished much additional information in regard to the requirements for a successful cultivation of plants. It has been learned, also, that of all the substances which enter into the composition of plants, only potassium, calcium, magnesium, iron, sulphuric acid, phosphoric acid, and carbonic acid, besides some nitrogen containing compounds, as ammonia or nitric acid, and water, are indispensable for their growth; while the functions of a few other elements quite frequently noticed in plants, as sodium, silicium, chlorine, etc., remain still less explained. As soil and air were thus proved to be equally important contributors of the essential articles of plant-food—the former furnishing the mineral constituents of plants, the latter mainly their organic portion—it became evident that the atmospheric resource of plant-food could only serve its purpose in the same degree as the soil-constituents present would be able to support them in the production of vegetable matter. To store the farm-lands with the largest possible amount of available essential mineral constituents of plants in particular has thus become the most important point of consideration in practical agriculture. The intelligent farmer recognizes this principle in the selection of his modes of operation. An early experience has taught him that the soil he cultivates differs more or less, as a general rule, in its physical condition and its chemical composition. Chemists have proved to him that any improvement in the former direction tends to render the natural and original resources of the soil treated sooner and in a larger degree available, and thus hastens on its final sterility in consequence of the production of larger crops. Superior mechanical treatment of the soil before seeding—rotation of crops, fallow, irrigation, and drainage—is for this reason resorted to mainly for the purpose of turning the natural resources of the soil to better account, either in consequence of a more uniform distribution of its plant-food or at the expense of time; while a continued unimpaired production is secured by returning in the form of some suitable fertilizer the soil-constituents which the removed crops have abstracted. The selection of a fertilizer is for economical reasons always made with reference to the nature and the amount of available plant-food in the soil under cultivation, and to the special requirements of the crops to be raised. Most home-made fertilizers are of a compound nature, while the commercial or artificial fertilizers supply usually but one, two, or three articles; they are for this reason frequently called "special fertilizers." Stable manure, although the most complex of home-made fertilizers, can not be considered a complete one as long as farmers sell a part of their produce. The commercial fertilizers furnish excellent means to correct the composition of the stable manure obtained under any system of agricultural industry, and to make it a complete fertilizer for the crops under cultivation. Although the stable manure represents still by far the largest bulk of the fertilizers used in general mixed farm-management, the demand for commercial fertilizers is already so great that their manufacture ranks among the most extensive branches of chemical industry. Their importance can not be overestimated in regard to the maintenance of the fertility of farm-lands as long as farmers still allow a fair portion of their home fertilizing material to waste, and as long as the sewage question of the centers of social life remains practically unsolved. Bones, mineral phosphates (see APATITE), and superphosphates—the latter frequently mixed with nitrogenous animal matter, as fish, blood, meat, etc., or ammonia compounds and nitrates—have been for years the main portion of commercial fertilizers. Phosphoric acid, lime, sulphuric acid, and nitrogen were thus for years duly represented in the market, while potassa and magnesia were less attended to. The sources of potassa for fertilizing purposes consisted formerly largely of niter and wood-ash; the former proved too expensive, and the latter insufficient in quantity, to encourage a more general application for agricultural use. The discovery of large mineral deposits at Stassfurt and elsewhere, containing both potassa and magnesia in soluble form, gave a peculiar interest to extensive and systematic agricultural experiments, by which their great value has been abundantly demonstrated. Many of the artificial fertilizers have acquired also an additional value on account of their special character, and thus their special action on the quality of various important crops for industrial purposes, as tobacco, sugar-beets, etc. The study of the peculiar influence of each article of plant-food in reference to the production of vegetable substances, such as starch, sugar, oil, etc., has engaged the particular attention of agricultural chemists.

The fact that important pecuniary advantages in the production of farm and garden crops may be secured by a judicious use of commercial fertilizers is universally recognized. As the success depends for obvious reasons in a controlling degree on favorable physical conditions and a definite chemical composition of the fertilizing materials to be used, a system of state inspection has been introduced to secure the desired information. Germany has taken the lead in that direction from an early date. In many parts of the U. S. the same course has been adopted. The laws adopted in different States for the regulation of the trade in commercial fertilizers as a rule agree in the following point: every package of material offered for sale for manurial purposes must be accompanied by a plainly fixed statement stating the amount of nitrogen, potash, and phosphoric acid it contains. CHARLES A. GOESSMANN.

Fes'cennine Verse [transl. of Lat. *carmen Fescenni'num*, pl. *versus Fescenni'ni*; *Fescenninus*, deriv. of *Fescennia*, name of an Etruscan city]: in ancient Italy, a rude and generally extemporaneous kind of poetry, often roughly satirical and licentious, sung at first in rustic communities at harvest-homes and weddings, and afterward introduced into Rome, where it was long popular. This verse was originally in form a dialogue.

Fesch, JOSEPH: cardinal: half-brother of the mother of the first Napoleon; b. at Ajaccio, Jan. 3, 1763; was a commissioner attached to the French army of Italy 1795–99; Archbishop of Lyons Apr., 1802; ambassador to Rome and cardinal 1803; grand almoner and senator 1805; president of the Council of Paris 1811; then retired in disgrace to Lyons for opposing Napoleon 1811; on Napoleon's second fall in 1814 retired permanently to Rome, and there d. May 13, 1839. His correspondence with Napoleon was published by Albert Du Casse in his *Histoire des négociations diplomatiques* (3 vols., Paris, 1855), vol. i.; his *Life* by J. B. Lyonnet (2 vols., Lyons, 1841).

Fescue [corruption of *festue* < M. Eng. *festu*, a straw, from O. Fr. *festu* > Fr. *fétu* < Lat. *festu'ca*, stalk, straw]: any one of numerous species of grass of the genus *Festuca*, which abound in most temperate regions of the globe. The sheep's fescue and the tall fescue (*Festuca ovina* and *elatior*) are excellent pasture and forage grasses. Peru has the *Festuca quadridentata*, which is reputed poisonous to stock. The European fescues are more numerous and important than the American.

Fessenden, THOMAS GREEN: poet and agricultural writer; b. at Walpole, N. H., Apr. 22, 1771; graduated at Dartmouth College 1796. He studied law, but the success of a poem, *Jonathan's Courtship*, led him to literature. In 1803 he wrote in London *A Terrible Tractoration*, a satirical poem; in 1804 settled in Boston, publishing there, in 1806, *Democracy Unveiled*, a political poem, etc. Afterward he edited the *Weekly Inspector* at New York city two years. In 1812 practiced law at Bellows Falls, Vt., removing to Brattleboro, Vt., in 1815, where he published *The Reporter*. From 1816 to 1822 he edited *The Intelligencer* at Bellows Falls, Vt. From that time until his death, at Boston, Nov. 11, 1837, he published *The New England Farmer* at Boston, Mass., and edited *The Horticultural Register*. Among his works are *Original Poems*; *The Ladies' Monitor* (1818); *American Clerk's Companion* (1815); and *Laws of Patents for New Inventions*.

Fessenden, WILLIAM PITT, LL. D.: statesman; b. at Boscawen, N. H., Oct. 16, 1806; graduated at Bowdoin College 1823; admitted to the bar 1827; began the practice of his profession at Bridgeton, Me., removing two years later to Portland, Me., where he continued to reside, and with whose interest and progress he was ever identified. Chosen as a Whig to the State Legislature in 1832, though the youngest member of that body, he attained distinction as a legislator and debater; refusing further political preferment, he devoted himself (1832–39) to his profession, rising to the highest rank as counselor and advocate. He was, however, returned to the Legislature in 1840, and in 1841–43 represented his district in the Congress of the U. S., where he made a brilliant record as an eloquent and forcible debater; was returned to the State Legislature in 1845 and 1846, and again in 1853, when he was elected to the U. S. Senate as a Whig, though the Legislature was Democratic. He took his seat Feb., 1854, and was placed upon the finance committee, and the following month made one of the most eloquent and effective speeches delivered against the Nebraska bill, establishing him at once as a leading member of the Senate. Re-elected in 1859, he was made chairman of the finance committee, and throughout the civil war rendered valuable service as such, by aiding the Secretary of the Treasury to maintain the national credit, as well as by his eloquence and counsel in the Senate chamber. In 1864, on the retirement of Mr. Chase from the Secretaryship of the Treasury, he accepted that portfolio, and discharged the duties of the office during a most critical period of the nation's finances until Mar., 1865, when, owing to his delicate health and the overwhelming duties of the office, he resigned and resumed his seat in the Senate, to which he had been re-elected. On the conclusion of the impeachment trial of President Johnson, he cast his vote for acquittal, in accordance with his opinions, which he set forth fully in an able and logical speech. For this act he was severely censured by his party, which was strong for conviction, but no taint of suspicion could be attached to the integrity of his vote, and he regained its confidence upon the subsidence of momentary excitement, and retained his place in the Senate as a leading debater and member of the party. He was for a number of years an invalid, and suffered from a chronic complaint that finally hastened his death, which occurred at Portland, Me., Sept. 8, 1869. Revised by C. K. ADAMS.

Fess'ler, IGNAZ AURELIUS: author; b. at Czurendorf, Hungary, May 18, 1756; was at first a Capuchin (1773), but in 1791 became a Protestant; was 1785–87 Professor of Oriental Languages at Lemberg, and in 1809 received the same chair at St. Petersburg, and afterward was a prominent Lutheran official in Russia. Besides novels, Masonic treatises, etc., he wrote *Marc-Aurel* (a romance, 1790–92); *Matthias Corvinus* (1793); *Aristides und Themistokles* (1792); *Attila* (1794); a history of Hungary (1812–25); and an autobiography (1826; 2d ed. Leipzig, 1851). D. at St. Petersburg, Dec. 15, 1839.

Festival: See FEAST.

Fes'tus (in Gr. Φῆστος), PORCIUS: procurator of Judæa; succeeded Antonius Felix A. D. 60, while Nero was emperor. On his arrival in his province he found the apostle Paul a prisoner, examined his case, refused to gratify the vindictive feelings of the Jews against him, and would have set him at liberty, but as the apostle had appealed to Cæsar (i. e. Nero), he sent him to Rome to lay his case before the emperor. The disturbances caused by the robbers, assassins, and magicians which had prevailed in the time of Felix still continued under the government of Festus, and he was obliged to use vigorous measures to subdue them. Died about two years after his appointment, and was succeeded by Albinus. Revised by G. L. HENDRICKSON.

Festus, SEXTUS POMPEIUS: a Latin grammarian and lexicographer; of uncertain date, but after Martial (A. D. 100), from whom he quotes, and before Charisius and Macrobius (400 A. D.), who quote from him. No particulars of his life have come down apart from his connection with the great work of VERRIUS FLACCUS (*q. v.*), *De Significatu Verborum*. Festus prepared an abridgment of this work, which he arranged under the letters of the alphabet into twenty books, following the order and authority of Flaccus, introducing additional matter from his other writings, but rejecting certain points, which he intended to treat of in his *Priscorum Verborum cum exemplis*. This abridgment, entitled *De Significatione Verborum*, caused no doubt the loss of the original work of Flaccus, but it would have been, even in its reduced form, an exceedingly valuable treasure-house of the forms of Latin words and of Roman antiquities and mythology. In the eighth century, however, Paulus Diaconus (*q. v.*) made a meager abridgment of Festus's work, adapted to the wants of his own time, and thus no doubt caused the discontinuance, and finally the disappearance, of the latter. One manuscript only of the eleventh century, now preserved at Naples, survived, but in a very imperfect condition, as it began with the middle of the letter *M*, and part of the remainder was defaced by fire. The labors of many scholars have been bestowed on the restoration of this important work, from some slight fragments of the original treatise of Flaccus, from the surviving MS. of Festus, and the compend of Paulus. The results are presented in their best and most complete form by K. O. Müller (Leipzig, 1839), who has printed the several works in separate columns. Part I., giving the text of a new edition by E. Thewrewk de Ponor, appeared in Budapest, 1889. Revised by M. Warren.

Fetials, or **Fecials** [in Lat. *fetia'les*. Etymology unknown]: a body of ancient Roman priests who had charge of certain international affairs, acting as heralds in the announcement of war to a foreign state, and presiding over the solemnities attending the return of peace. They were probably twenty in number, were anciently citizens of high birth, were chosen for life, and were called *patres patrati*. Their duties were performed with much ceremony. Their rites and regulations constituted a code known as the *Jus fetiale*.

Fetich: See Fetish.

Fet'id Gums: in pharmacy and medicine, certain gum-resins which are the concrete natural juices of umbelliferous plants. They have a strong, unpleasant, alliaceous odor, whence the name. They are antispasmodics and expectorants. Assafœtida, ammoniac, galbanum, and sagapenum are the best known.

Fétis, fā'tees', François Joseph: writer on music and biographer; b. at Mons, Belgium, Mar. 25, 1784; studied at the Conservatory of Paris in 1800; organist and Professor of Singing at Douai in 1813; director of the conservatory at Brussels in 1833; member of the Academy of Belgium in 1845; musical executor of Meyerbeer, producing his *Africaine* in 1864; officer of the Legion of Honor in 1864; grand officer of the Order of Leopold 1869. He published treatises on music, *Biographie universelle des musiciens* (Universal Biography of Musicians, 8 vols., 1834–44; 2d ed. 1868–70) and *Histoire générale de la musique* (General History of Music, 8 vols.). Founded and edited the *Revue Musicale*. D. in Brussels, Mar. 27, 1871.

Fetish, fee'tish [viâ Fr. from Portug. *feitiço*, artificial, applied by the Portug. in Africa to native objects of worship < Lat. *facticius*, deriv. of *facere*]: an object worshiped by the degraded tribes of Senegal and Congo. A fetish is not an idol, and is not properly a symbol, but is looked upon as the actual and visible dwelling-place of a preternatural power. It may be thus some fixed object of nature, as some lofty mountain, a grove, or a tree; it may be an animal, as a snake, a snail, a crocodile, and often a sheep or a goat; or it may be any object on which the whim or the fancy has fixed, as the beak of a bird, the fin of a fish, the hoof of a quadruped, a stone, a block, a feather, a stick, a nail, or almost anything else that can be named. One thing will do about as well as another for a fetish, provided the worshiper can believe that his god resides therein; and this he is easily led to do in reference to anything which pleases or is useful to him. A fetish is often worn about the person or hung up in the hut as a talisman, and is employed in the most disgusting rites of superstition and witchcraft. Fetishism shows the religious instinct degraded into its lowest forms. See Animism.

Fetlock [M. Eng. *fetlok*, *fitlok*, from Scand., but etymology uncertain. The second element is equal to Eng. *lock* (of hair): Icel. *lokkr*, and the first probably equal to Eng. *foot* (cf. Icel. *fet*, a step)]: the point on a horse's leg behind the pastern-joint. The fetlock is covered by a tuft of long hair.

Feud: a legal term used to designate land held of a superior, on condition of rendering him service. The term is opposed to *allodium*, the absolute or ultimate property, which continued to reside in the superior.

Feudalism: See Ethnology and Feudal System.

Feudal System, The [*feudal* is from Mediæv. Lat. *feuda'lis* (cf. Fr. *féodal*), deriv. of *feudum*, from O. H. Germ., *fihu*, *fehu*: Goth. *faihu*, cattle money. See Feoffment and Fee]: a form of society, prevalent in Europe during the Middle Ages. In the Roman empire, as in all compact states where the central power has its due degree of strength, the individual was placed directly under the supreme magistrate, and all authority of subordinate officers was exercised in his name. This dependence of the freeman in the direct way on the head of the state continued in the Germanic kingdoms, after they superseded the Roman power, for a length of time. In the tenth century, however, a new set of institutions began to work, rooting out and breaking up the institutions of the state proper. To them is given the name of *feudalism*, *feudality*, or *the feudal system*. They developed themselves, without absolutely destroying all earlier institutions, in France, England, Germany, Spain, Italy, and in the neighboring lands of Hungary, Poland, and Denmark. They appeared also in other parts of Europe, and out of Europe in the Christian kingdom of Jerusalem. If traced back, they must be brought into connection with the Germanic element which diffused itself by invasion over a large part of Europe, while yet there was, properly speaking, no feudalism among the invaders. It is a mistaken notion that the invading armies consisted of bands under chieftains to whom the conquering kings gave lands for their services, and who in turn gave lands to their *comitatus* or retainers. Feudalism was a German growth, but had no such antique and tangible shape. It grew up, by little and little, out of institutions which were ripened in the Carolingian period, no one of which is enough of itself to explain feudalism, and which in combination could not have brought it about but for concurrent historical causes.

Feudalism controlled society and government for several centuries and began to grow weak at the same time that the countries of Europe began to be nationalized; that is, at about the end of the fourteenth century. It was, however, not the sole, but only the controlling, power of society. The Church, the suzerains, the towns, were at heart its foes, although they put on some of its forms.

The word *feudum* in Mediæval Latin, from which *feudal* is derived, did not come into use until about the ninth century, when it began to take the place of *beneficium*, which denoted a property given for use on certain conditions, the ownership of which did not go over with the usufruct. *Feudum* and *allodium* included the two tenures by which property was held in independent right—in fee-simple, as we say—and by which it was held on condition of performing a service to the former owner.

But what was the feudal system? It may be defined as that political form in which there was a chain of persons holding land of one another on condition of performing certain services, beginning with the serfs and lowest freemen, and ascending through *milites*, or knights, to the arrière-vassals and immediate vassals of the suzerain. Every member in the chain, from the milites upward, was bound to his immediate superior, held land from him, took the oath of allegiance to him, and became his man. The suzerain, then, had, when the system was pure, no direct connection with any but the great vassals, and they, with others, it might be, under them, were lords in their districts. The legal fiction was that the land was originally in the hands of the suzerain (that is, all the land which was not allodial, of which there was much in Germany, but in France very little); that allegiance and certain services fixed by custom were due to him; and that for neglect to perform these services the lands and all rights going with them could be forfeited. With the lands, down to the holders of knights' fees, jurisdiction was connected, as well as legislation within certain limits, military command over the fief-holders of the barony, and, to a considerable extent, the right of coining money, together with that of giving charters. In short, nearly all sovereign powers passed over from the old sovereign—who now must be called a *suzerain*, to show his altered position—to his vassals; so that society was disintegrated, as much as it would be if every county in one of the U. S. had the right of holding courts of itself and of passing laws. This it is that formed the most marked peculiarity of the system, and obstructed for centuries all uniform development, all national existence, all unity. In this disunited condition there grew up endless diversities of customs; there was for a long time no general law; every feudal connection stood on its own foot, and was subject to compact between the suzerain and the vassal, a lord and an inferior. For instance, if a baron died and left no son, females could not inherit, but in the first part of the twelfth century they began to gain this right in Eastern France, England, Castile, Aragon, and the kingdom of Jerusalem. By this change it was brought about that females could inherit the throne, this being viewed in the light of a fief. And thus the law of succession in some monarchies took more or less definitely a new shape. This is one of many instances which will justify the statement that in European feudalism public or political relations were confounded with private relations—political rights were blended with private rights.

The origin of the system has been traced by some writers to the Roman custom in the empire, from the time of Alexander Severus, of protecting the borders toward Germany by military colonies, in which the soldiers received land and were bound, they and their descendants, to military service. This, which was by no means confined to the Roman empire, but is seen in other parts of the world, was perhaps suggested by a Germanic usage. As Waitz says (*Deutsch. Verfassungsgesch.*, i. 376), "the way in which, among various Germanic tribes, Scandinavian as well as Teutonic, military service was united with possession of land, gives a probability to the opinion that even in the earliest times a certain connection between them subsisted." But this is the least characteristic element of the feudal system. It does not account for subinfeudation, or for the political powers which the fief-holder had, which was the striking characteristic of feudalism.

Neither can the *comitatus*, or relation of the *comites* or companions to the *princeps* or chief, as existing among the Germans of the time of Tacitus, account for feudal institutions. That was a relation of any chieftain to his companions, and not of a German king only to his followers. And that relation conveyed no political authority.

The true account of the matter seems to be this. Under the first race of Merovingian kings the kingdom was modeled much after the plan of the Roman empire. The county was assigned to a man (a *comes* or "count") who was both civil and military ruler, who commanded the forces of the county, administered justice, had no hereditary right to jurisdiction, but who might have grants of land for his lifetime, or on some other condition, from the king.

During the reigns of the later Merovingians, and after the East Frank or Carolingian dynasty got possession of the throne, there were growing up several institutions in some respects new, in some respects analogous to older Germanic ones. These were vassalage and commendation, the beneficiary system, and immunity or exemption. To give a complete exposition of these elements of new social and political forms, and indeed to exhibit full-grown feudalism in its details, would require far more space than can be here afforded. A brief outline is all that can be given.

1. *Beneficia and the Beneficiary System.*—This was a relation of *property*, and long before the feudal system proper grew up *beneficium* denoted a gift of property, especially of landed property, in usufruct only, with reversibility to the donor or his heirs. The early meaning still appears in the word "benefice," in its sense of an ecclesiastical property, the use of which is given to a clergyman as officiating in a certain parish. The donor or grantor of the *beneficium* might be a king, any lay person, any ecclesiastical corporation; while the grantee might be any man, even the king himself, or a female, or a corporation, as before. *Beneficia* given for a short term of years or revocable at pleasure were called *precaria*—that is, obtained by the prayers or requests of the beneficiary; and the short, uncertain tenure of such holdings illustrates the modern word "precarious." But the distinction between *beneficia* and *precaria* is by no means a perfectly exact one. Such precaria were given, for instance, where a donor of land to a monastery in full ownership received it back in usufruct, with perhaps some of the older Church property besides.

Beneficia are distinguished in the course of time from leased lands transferred for use to dependent persons, such as serfs. Thus a monastery might have serfs on its lands or free tenants. The lands so cultivated by them were not regarded as *beneficia*, but a man who received from such a foundation tracts of land to be cultivated by his own people, or lands with laborers on them, would be called a "beneficiary."

The terms and conditions on which such benefices were held were very various. Some were for short terms, some were renewable every five years, while others were expressly excepted from this condition. *Beneficia* of the king usually terminated with the life of the grantor or of the grantee, but sometimes they passed on to the grantee's heirs. Under the grandsons of Charlemagne they came to have more and more of an hereditary character, and in the kingdom of the West Franks (or France) a sort of acknowledgment of the hereditary principle was made in 877 A. D. by Charles the Bald at the convention or diet of Quiercy-sur-Oise (*conventus Carisiæus*). Yet diplomas of Charles the Bald show that this rule of inheritance was not absolutely fixed by the celebrated capitulary referred to. And this provision had no necessary authority in other parts of the kingdom of Charlemagne. On the renewal of grants of benefices sometimes money was demanded, reminding one of the subsequent fine or relief, but this was not thought to be becoming. The obligation for holding a benefice might be something like a rent, real or nominal, or no requital of any outward sort might be called for. But a certain kind of tie grew out of the giving and receiving of benefices—something expressed by the Latin word *obsequium* in the formulas of gifts—that is, a readiness to comply with the wishes of the benefactor; if he were the king, a personal feeling of gratitude apart from the sense of duty as a subject. This is expressed in a form of which the following is a translation: "Let him know that he ought to show such (*obsequium*) dutiful compliance toward his senior on the ground of that gift, as other men, on the ground of similar beneficence, are wont to show toward their seniors." Here is seen the reception of benefices becoming connected with

2. *Vassality* or *commendation*, which was a merely *personal tie*. The latter of these words has the more extensive meaning, and several relations were described by it besides that which was called "vassality." The essence of these relations lay in formally putting one's self under the protection of another. The king was regarded as the protector of certain helpless classes, such as widows and orphans. They were *in his peace*, as also were the whole people and the Church. So, too, pilgrims and travelers were for the time under his care—under the tutelage or the defense of the king—although *commendation* is not the term specially used in such cases. Again, young men brought to the court to be trained for some service or court office are said to be commended, although no formal taking of them into his protection or guardianship (*mundium*) may have found place. Nor was the king alone in giving his protection. The *major domus*, or mayor of the palace, sometimes gave his protection with or instead of the king, and Pepin made his son Charles (Charlemagne) joint protector with himself. The property of a diocese might be in the tutelage of a count—that of a convent under a count's or bishop's protection. Free men put themselves under the guardianship of a convent. Thus originally there were manifold relations, differing, yet having resemblances to one another, which were described by the same words.

A person who made commendation of himself was called *vassus* or *vassallus*, a word probably of Celtic origin, and at first denoting a servant, then in time confined to the relation above spoken of. (See Waitz, *Deutsch. Verfassungsgesch.*, iv. 205, for examples of the use of the words as applied to inferior proprietors.) Another equivalent term was *gasindus*, of Germanic origin (cf. Modern German *gesinde*), and another still was *homo*, of Latin origin, whence *homage* comes. The person who received another into his protection was especially called *senior* (whence *seignior*), and also *dominus*. In later documents the seignior's relation or standing is called *senioratus* (as if seigniorship). The entrance into the relation of a vassal was denoted by the form of folding the hands together and laying them in the hands of the *senior* or protector. This was accompanied by an oath containing a promise of fidelity. The oath and the form in general were used as well when a count or other important person took an inferior under his protection as when the king received a vassal into his service. The oath and obligation were contemporaneous with the general oath of allegiance on the part of the subjects as required by Charlemagne and other Carolings. And yet the oath to the king's or emperor's subject certainly tended at length to weaken the tie between the head of the state and those members of it who were bound to others than the sovereign or suzerain.

The vassal sometimes remained with his senior, especially if the king was the senior, and served in his court; sometimes he lived remote from the king on lands which had been given to him for his use. If an inmate of his senior's dwelling, he was bound to services, such as military duty, going on messages, presence at his courts (*placita*), following in his train. In a capitulary of A. D. 811 it is said of such vassals of the king that if they have benefices, and vassals on them, they shall not keep these subordinate vassals with them, but "shall allow them to go with the count to whose district they belong." From this it appears that already vassals had vassals; that some vassals had no benefices; and apparently, also, that the old-received jurisdiction and military power of the count in his county (*pagus*) was beginning to be weakened, for it was necessary to give orders that such vassals should follow the count to his county and upon military expeditions.

At first the tie between a person other than the sovereign and his man was probably weaker than that between the magnates and the king. In the disorders after Charlemagne's death, and in the time of his grandsons, the great people seduced each other's vassals away, so that this had to be expressly prohibited. The vassal also could not leave his senior or lord except for reasons which involved a crime on the senior's part, unless, indeed, the latter freely dismissed him. Such crimes as mentioned in a capitulary of Aix-la-Chapelle (A. D. 816) are attempts on the senior's part to enslave the vassal, seduction of his wife by the senior, plots against his life, running upon him with a drawn sword, neglecting to protect him if this were in the senior's power. With this may be compared the feudal crime of felony, which is generally committed by the vassal against his lord, but may also be committed by the lord himself against his vassal.

It came to pass in the course of time that vassals held benefices and beneficiaries became vassals—that is, that no person could stand in the one relation without its involving the other. Waitz says (*Deutsch. Verfassungsgesch.*, iv. 216) that "no one could get a benefice without binding himself by commendation more closely to the grantor of the land—more closely than would take place by the fact of having another's land put for use into his hands." Roth, in his *Beneficialwesen*, says more safely that this union of the two relations was usage only for some time, and not universal custom. When the custom was becoming universal a class of landholders was growing up who held estates by a tie of personal obligation to a superior; and this class, owing to the vasts tracts of land which the Frank kings could dispose of, embraced a large part of the leading persons, especially in the West Frank kingdom.

3. *Immunity* (*emunity*) or *exemption*, a *political* privilege, was the third constituent element of the feudal system. The first form under which this element appears is immunity from taxes or burdens on the land. When the king gave benefices he transferred that which before belonged to the *fisc*, and which was exempt from taxes. It was a great thing for a person to obtain this exemption. The first exemptions that are known are all granted to convents or to other ecclesiastical foundations, the property of which was entirely derived at first from gifts of lands. Originally, this grant of immunity could only proceed from the king, yet documents issued to such corporations by nobles who were vassals of kings confer it, in the expectation, perhaps, that a confirmation of the step would be obtained from the supreme authority. There seems also to have been a special anxiety on the part of convents that a public officer should not enter within their premises and disturb their sacred quiet. However little or much this cause may have effected, the immunity naturally took the shape under Pepin and the next sovereigns that no public officer should enter the court or lands of the foundation, either to levy peace-money (*freda*), or to demand quarters and lodging, or to take securities, or to hold the people of the foundation to justice, or to set up judicial proceedings there. These dispensations from what was due to the state were not granted all at once, but one at a time; and, on the other hand, there were cases where the public officer might enter the religious precincts. These privileges were eagerly coveted, and in regard to nothing in the mediæval times do so many forged documents exist as in regard to these grants of immunities. They were protected by fines very considerable in amount. But as free men commended themselves to the Church corporations to get rid of public service in war, an edict of 825 gives the counts the right to distrain on them, "notwithstanding the immunity." In some cases this privilege was given for hedged or inclosed lands only, not for plow, pasture, or wood lands, at least so far that breaches of it should not have the same penalty outside of the court and buildings as within.

This privilege evidently could amount, if bestowed on all holders of benefices (or fiefs, as we now may call them), to an overthrow of direct public power, and was evidently worth the efforts of the secular proprietors to secure for themselves. When and by what steps they obtained it does not so clearly appear as in the case of convents and other Church foundations. But such a privilege could not be confined to ecclesiastics, and in the unquiet times under the grandsons of Charlemagne and afterward, public power became weak, while at an equal pace the power of the landholding grantees became great. The smaller free proprietors could not stand alone in those times, but found it necessary, in order to protect themselves, to join some society where they could find protection, and so gave up their lands to a count or other great person, to receive them back as his men owing allegiance and securing support. The counts would naturally be large landholders within the county, and if their functions, at their death, passed out of the family, the son would naturally want to have the same authority in his estates which his father had in the county or district. These are some of the reasons which brought it about that multitudes of men, ecclesiastical and civil, in process of time got exemptions from public authority—that is, as far as justice, police, military headship were concerned—broke up society into fragments, and denationalized a great part of Europe.

These three causes, then, working together, produced the feudal system. Public property, by the distribution of lands in the way of beneficiary gifts, which were finally held by hereditary right, created great proprietors. Vassalage connected these proprietors by a personal tie with one another, and at length *only* with one another, the high vassals alone having immediate relations to the sovereign. Finally, immunity distributed in process of time the principal powers of the state to the vassals of the suzerain or to their vassals also. In this course of things different parts of Europe moved forward independently. In France, where there was very little allodial property, the maxim of feudalism was "Nulle terre sans seigneur." In Germany there were many small free proprietors who stood their ground, as in Ditmarsch, and many large proprietors whose allods alone, without their fiefs, were very wide territories. When Henry the Lion was deprived of both his Saxon and Bavarian dukedoms, in 1180, for his want of fidelity to Frederick Barbarossa, he had still in his hands the extensive Brunswick territories, which when divided up made several important German principalities.

In another particular, which was of no inconsiderable moment, the countries differed. In France all the feudal holdings became hereditary at an early day. It was otherwise in Germany and in Italy. In Germany there had been no acknowledgment of the right of the great vassals to transmit their imperial fiefs to their children until the Emperor Henry II. silently acknowledged it in every known instance but one (1002–24). But still, the princes retained the right to dispose of the fiefs on the death of arrière-vassals as they pleased, until Conrad II. (1024–39) gave it to be understood—without any positive law, as it would appear—that the same usage must prevail toward them also, and thus raised up a class of friends to the imperial power among the smaller nobility. In Italy things were even worse for the arrière-vassals—the *valvassors* as they were called—until the same emperor by his constitution, given out before Milan, granted to the valvassors the right of inheritance in their fiefs, of trials by their peers, of appeal to the emperor or his deputies the counts palatine, and of security against the conversion of fiefs into leasehold or copyhold properties—a measure by which he made friends of the smaller nobles, and took away arbitrary power from the larger.

Feudalism grew up and spread in the different parts of Europe amid so many different influences, favorable or counteracting, that its minor diversities in the several countries were countless. Thus in France the north was especially the home of customary law (*coutumes*), while the south retained influences from the Roman times. In England a Duke of Normandy, a vassal of the French Capets for his French possessions, is supreme ruler under no superior, brings the land and land tenures into the forms of feudalism, but endeavors to mitigate the disintegrating tendencies of that system and to uphold the royal power by modifications more or less drawn from the Saxon institutions. In Germany an elected emperor, an intimate connection with the papacy, a necessity during a long time for a vigorous head to protect the land from Eastern neighbors, with various other causes, gave a peculiar turn to many of the institutions. Here the old Teutonic ideas stood their ground, while foreign law and institutions crept in from Italy. So also in the internal affairs of each part of Europe, opposing elements were at work and there was a most vigorous, unquiet life; the kings, at war with their principal feudatories, leaned for support on the towns or the lawyers; the Church was feudalized, but in contest with the unruly nobles, and falling back upon the ecclesiastical unity represented by the pope. Further, new institutions like the towns were arising, capital other than land was becoming important, unions of the citizens of various communities against the nobles were coming into existence.

The theory of feudalism, not true in matter of fact, has been already stated to be that all the land belonged originally to the king, and was given over on certain conditions to his principal vassals, and by them to theirs. Long after the fiefs became hereditary their original lapse into the hands of the superior was indicated by the fine or payment called *relief* which the heir paid on entering into possession of his father's or next relative's possession. As the tenure was personal, the holder of a fief could not sell it without his lord's consent, who had on such occasions the right of prior purchase, called *rachat*. The necessity of defending the kingdom or fief led for a time to the exclusion of females from succession, and, especially in France, to the indivisibility of a fief where a deceased person had left more than one son; but to these rules there were extensive exceptions. Where more than one fief pertained to a family, a subordinate one might be given to a younger son. In Germany subdivision among the male children of the fief-holder was the general rule. It was natural that if an unmarried daughter succeeded to the fief, the superior's consent should be necessary before she could marry the man of her choice. Again, when an heir was a minor there was a propriety that the superior should be his or her guardian—a very gainful thing for the higher vassal or for the suzerain.

As for the termination of the feudal relation, it could cease by extinction of the line; by the vassal's felony toward his lord, which comprehended a number of the grossest and most dishonorable actions in violation of his feudal oath; by the felonious conduct of the superior against his vassal (which has already been spoken of); or by the vassal's voluntary relinquishment of his fief where this was permissible. When a vassal's crime subjected him to loss of his fiefs, a judgment of a court of peers was necessary; the superior could not generally, by his own act, without such consent, declare him to have forfeited his estate. The most remarkable cases of such trial were that by which John of England, on sentence of his French peers, was stripped of the lands he held in France by homage as a vassal of Philip Augustus (A. D. 1203), and that by which Henry the Lion in 1180 lost the dukedom of Saxony, as has been already mentioned.

As feudalism grew up, not only laymen but ecclesiastics and corporations were invested with fiefs, and in fact the great bishops and abbots ranked in some countries among the most important feudatories. The kings were quite willing to have such vassals, for the lay barons gave them trouble by active resistance more frequently, and there was an opportunity, on the death of a feudal ecclesiastic, of influencing the appointment of a successor, as well as of deriving advantages from the introduction of a new ecclesiastical person into the feudal relation. But as the ecclesiastics holding fiefs had two characters—that of feudatories and that of churchmen under the Pope—it was natural that just at this point there should be a conflict of secular and religious authority. The most important struggles of the Middle Ages grew out of the two characters of the ecclesiastical princes, the sovereigns being unwilling to give up their feudal rights over Church lands held as fiefs, and the popes claiming the independent relation of the great ecclesiastics toward the sovereign, as well as the inalienability and sacredness of lands once consecrated to religious purposes. As the bishops and abbots could not sit in capital trials according to the canons, and could not without irregularity take part in traffic, they needed lay vicars, who often managed to enrich themselves and grow into power at the expense of the foundations.

The complexity in the feudal system was increased by the fact that not only land, but everything that could be held as property, could take the form of fiefs. So also certain offices at the suzerain's court, as those of the high chamberlain, butler, seneschal, constable, pertained to certain families; and the counts palatine, who were originally assistants of their suzerain in the administration of justice, transmitted their title and the lands connected with their office to their sons.

The principal obligations of the fief-holders or vassals were the following:

1. Service in war (*service d'hoste*). The customary obligation in France, when the superior was involved in war or followed his own superior in war, was a military service of forty days with his men or with a fixed number, after the expiration of which the vassal could go home, although the war was not at an end. If certain specific reasons prevented his appearing at all, a fine (in Old French an *écuage*) could be demanded from him. Such a limited time of service, of course, broke up many expeditions. Hence in France—which is selected as especially the feudal country—toward the end of the eleventh century fiefs were granted on the condition that the vassal should serve until the end of the war. The vassal under these obligations was especially a liegeman (*homo ligius—ligius* being derived from the Latin *ligo*, to bind, most probably), while the vassal bound to definite service was his lord's man simply, and his relation was called ordinary homage (*hommage ordinaire*). Still another kind of service, called *hommagium planum*, bound the vassal neither to service at his lord's court nor to service in war, but simply to fidelity and neutrality. Others, still, were bound to defend only a castle of their superior, and were maintained at his expense.

2. Another general obligation was that called *justitia*, or that the vassal must appear, when summoned, at his lord's courts, either to act the part of a judge, together with his fellow vassals or peers (*pares curiæ*), or to submit to trial before them as judges. The rule was trial by peers, and the power of administering justice was vested in all the gradations of the feudal persons down to the knights (*milites*), who themselves, if there were free persons on their estates, were their natural judges. The great lords did their office by deputies for the most part, and in process of time their vassals came into the habit of having their representatives also. Besides other proof, wager of battle or trial by combat was a common method of deciding cases in these courts, being a kind of feudal ordeal.

3. *Aids or Auxilia.*—These were money payments, determined according to feudal usage. They were due in France and in England when the lord was to be redeemed from captivity, when his son (or eldest son) was made a knight, and when his daughter (or eldest daughter) was married. (Cf. *Magna Charta*, § 14.) At one time aids were demanded and given when the lord went on a crusade.

Besides these, the specific duty of fealty implied general respect and obedience, honesty in not altering the condition of the fiefs, and similar duties.

The feudal system not only broke up countries into almost independent parts, encouraged private feuds, and made the leaders of society a law unto themselves in great measure, but it rested on a system of serfage, which appears as well among the Germans before the emigrations as in the later Roman empire. Under it there could be no unity except that of the Church. Its evils were immense, but amid the evils, by the help of Christian ideas, there grew up the sentiments of honor and of fidelity, the spirit of courage and of personal independence, the sense of obligation to protect the weak, a new respect for woman unknown to the classical nations. Among its good principles of a political kind, those of trial by peers and of taxation only by consent of the tax-paying inferior were the most important.

At length the feudal system began to fall; new political ideas and forms, new powers in society, began to take its place; nations arose out of separate fiefs, and suzerains again became kings. What broke up feudalism? The most prominent immediate causes were the substitution of a better law in the place of feudal law, the growth of the cities, and new methods of warfare. These causes added strength to the central power, created an opulent class outside of the feudal nobility, gave birth to new political institutions, helped somewhat the lower classes, and brought in new knowledge, a new civilization. In the first place, as the feudal law was found inapplicable to the new circumstances which the growth of cities and of industry had introduced, the Roman law was called in the twelfth century out of the obscurity where it had long lain in the north of Italy; and the University of Bologna owed its origin or its first prosperity to this study. Hither multitudes resorted for the purpose of learning the new science. From this starting-point it was propagated through Europe. The courts of the suzerains made use of it, and with the more effect owing to the fact that the appeals to their courts, which had in France at least been long disused, were revived. In this way a code which was favorable to the growth of a central power began to prevail over one unsuited to the times, and the kings began anew to be regarded as centers of justice. In the next place, the growth of towns all over Europe in and after the crusades was a source of changes in the political system. The towns acquired privileges by especial charters granted by their feudal lords, whose resources might in this way be increased. As they grew they became a new power, which, like the suzerain's, was naturally opposed to the feudal power. The kings aided them because both were enemies of the feudal nobility, and they in turn helped the kings. Their self-government, capital, and common interests made the towns, though isolated, aware of their strength; they were able to send deputies to the estates-general, parliaments, or cortes through which nations expressed their national feeling; they could give assistance to the kings in struggles against the feudal element by their men and money. Louis IX., who died in 1270, the best sovereign in the Middle Ages, in his testament exhorted his son to be mindful of the interests of the "good towns," as if there were a natural alliance between them and the sovereign.

Again, the new modes of warfare had advantages over the feudal military system, which was heavy in its movements and unreliable. Its great strength lay in its mail-clad horsemen. The use of cross-bowmen, gunpowder, guns, and cannon, and of a population in the towns or of freemen in the country who could serve as hired soldiers, changed the face of war. The battle of Crécy, gained by Edward III. of England in 1346, was due to two causes—that a yeomanry had grown up in England earlier than in France, and that these intrepid freemen were skilled at the cross-bow. The battle of Agincourt (1415) was won by bill and bow, the French chivalry literally sticking fast in the mud, to be shot down by the English archers. The victories of Granson and Murten or Morat (1476) were won by free Switzerland over the troops of the most feudal of princes, Charles the Bold. What is remarkable here is that the superiority as it respects arms lay on the Duke of Burgundy's side, so that guns alone were not the cause of the fall of the feudal military system. But there is no doubt that the use of weapons capable of producing an effect at a distance gave to foot-troops, and to those who were cheaply equipped, a greater advantage over the heavy moving horsemen and the undisciplined infantry of feudalism, and thus helped the sovereigns and others who soonest availed themselves of the new instruments of war.

Underlying and acting with the other causes of the downfall of feudalism were the more general ones which indicated the progress of society. Intelligence was spreading in the middle class, but not so much in the higher. There were men in many towns who had traveled into the East and seen the institutions of the nations in remote parts; there were professional men who were cultivated in law or in medicine at the universities; there were great merchants whose views were enlarged by the intercourse which they kept up with the world; the arts were beginning to refine the dwellers in the towns; church architecture was already in its glory. It was impossible that capital, intelligence, the means of closer intercourse, should not have an effect in modifying political forms which had given power to soldiers and land-owners less intelligent and with less available capital. The feudal lords themselves in many places entered the town and became burghers, thus confessing that the center of social life was altered.

The feudal period, one of the most remarkable in the history of the world, passed away, leaving a multitude of influences which will never die out of civilization. It must not be despised—it ought to be justly dealt with—blamed and admired on good grounds. But it is becoming in the rapid progress of society more and more strange. Many of the institutions which sprang up in that institutional era need to be explained, as Roman and Greek usages are explained. The study of an age now ancient alone can make intelligible the origins of many customs and laws that are still vigorous. T. S. WOOLSEY.

Feuerbach, foi'er-baakh, LUDWIG ANDREAS: philosopher; b. at Landshut, Silesia, July 28, 1804; son of Paul Johann Anselm von Feuerbach, the jurist; in 1822 went to Heidelberg to study theology, but removed in 1824 to Berlin, where, under Hegel's auspices, he devoted himself exclusively to the study of philosophy. From 1828 to 1832 he lectured at the University of Erlangen, but his public denial of immortality made his promotion impossible, and he retired to Ansbach, then to the castle of Bruckberg. The failure in 1860 of a manufactory from which his wife had drawn her income led to his going to Rochenberg, near Nuremberg. Meanwhile he developed a great activity in literature, and wrote in German, besides numerous minor essays in periodicals, *Thoughts on Death and Immortality* (1830); *History of Modern Philosophy from Bacon to Spinoza* (1833); *Criticism of the Philosophy of Leibnitz* (1837); *Pierre Bayle* (1838); *Philosophy and Christianity* (1839); *The Essence of Christianity* (1841; 4th ed. 1883; Eng. trans. by Marian Evans (George Eliot), London, 1854; 2d ed. 1881); *Principles of the Philosophy of the Future* (1843); and *The Essence of Religion* (1845). D. at Rochenberg, Sept. 13, 1872. A national subscription was raised for him shortly before he died.

Ludwig Feuerbach is the representative of the modern atheism in its German form. His polemic is often boisterous and uncouth, but his positive views are entirely free from that coarse or supercilious materialism which characterizes the English and French atheism. He dissolves the idea of God into that of nature; construes religion as the product of a merely psychological process—natural, perhaps necessary, at one stage of human development, ridiculous and injurious at another. His views on this last point contain many deep and striking psychological ideas, and it is not until he approaches Christianity, and begins to construe its doctrines too as resulting from the weakness and confusion of the human spirit, that he becomes crude, and sometimes even puerile. See his *Life* by C. N. Starcke (Stuttgart, 1885).

Feuerbach, PAUL JOHANN ANSELM, von: jurist and reformer of criminal law; b. at Jena, Germany, Nov. 14, 1775; educated at the gymnasium at Frankfort-on-Main and at the University of Jena, where he studied first philosophy and then law. His *Critique of Natural Law* (*Kritik des natürlichen Rechts*, 1796) and his *Anti-Hobbes* (1798) at once gave him prominence as a juristic thinker, and won a favorable reception for the course of lectures which he now began to deliver on criminal jurisprudence. The views set forth in these lectures and elaborated in his *Lehrbuch des gemeinen, in Deutschland geltenden peinlichen Rechts* (1801; 14th ed. 1847) placed him at the head of the new school of jurists called Rigorists, who maintained that the decisions of judges should be strictly subordinate to the text of the penal law and never rendered at discretion. In the *Lehrbuch* he was also the first to systematically develop the intimidation theory of punishment, which he had previously advanced in his work on the *Crime of High Treason* (1798). The effect of Feuerbach's works was not only to arouse a strong feeling against vindictive punishments, but ultimately to effect a reform of the entire system of criminal jurisprudence. In 1801 he was made a professor at Jena, but in the following year accepted a call to Kiel. In 1805 he filled an office in the department of justice and police at Munich, and in 1808 was appointed privy councilor. Having attracted the favorable notice of the Bavarian Government by his *Critique of Kleinschrod's Project of Criminal Law* for Bavaria, he was commissioned to plan a new criminal code, which was promulgated in 1813, and subsequently taken as a model for the reformation of the penal codes of several other countries. He published *Merkwürdige Kriminalsrechtsfälle* (1808–11), and *Betrachtungen über die Geschwornengerichte* (1813), pointing out in the latter work the defects of the jury system. He wrote a number of patriotic pamphlets in the war of liberation 1813–14, and in the latter year was appointed second president of the court of appeal at Bamberg. In 1817 he became first president of the court of appeal at Anspach. In 1832 he published his *Crime against a Soul*, presenting the first careful analysis of the remarkable case of KASPAR HAUSER (*q. v.*). D. at Frankfort-on-Main, May 29, 1833, just after having edited a collection of his *Kleine Schriften*. See *Leben und Wirken Anselm von Feuerbachs*, by his son Ludwig, the noted philosopher (2 vols., 1852). F. M. COLBY.

Feuillants, fö'yaañ' [so called from *Feuillans*, a village near Toulouse where their first abbey was situated]: the members of certain congregations of reformed Cistercian monks and nuns. Jean de la Barrière, abbot of Feuillans (d. 1600), began the reform in 1567. The reform was approved by the pope in 1586 and 1587. Their first house in Paris was instituted in 1588. Their severe rule was mitigated in 1595. The congregation was divided in 1630 into that of Notre Dame de Feuillans and the reformed Bernardines (the latter Italian). Nuns were admitted to receive the rule of the Feuillants in 1588.

The original abbey at Feuillans (*Folium, Fulium*), in Haute-Garonne, Languedoc, 18 miles from Toulouse, was founded in 1162. The club founded in Paris in 1790 by Lafayette, Sieyès, La Rochefoucald, and others, and which advocated moderate opinions, called itself Feuillants, from the convent in which they met. On Mar. 28, 1791, it was broken up by a mob. The name Feuillants was in 1791 given to the right and the extreme right in the French legislature.

Feuillet, fö'yā', Octave: novelist and dramatist; b. at St.-Lô, Manche, France, Aug. 11, 1822; educated at the College of Louis-le-Grand at Paris, where he distinguished himself; entered upon his literary career in 1844 under the name of *Désiré Hazard*, and since that time has been a constant contributor to various newspapers and periodicals, and subsequently wrote many novels, comedies, dramas, and farces, most of which were received with much favor. Among his dramas are *La Nuit Terrible, La Crise, La Tentation, Redemption*, and *Le Sphynx*; and of his novels, the best known perhaps are *Bellah, Le Roman d'un Jeune Homme Pauvre*, and *La Morte*. In 1862 he was elected to fill the chair in the French Academy left vacant by the death of Eugène Scribe. D. in Paris, Dec. 28, 1890.

Feuilleton, fö'ye-tōn' [Fr., dimin. of *feuillet*, sheet of paper, dimin. of *feuille*, leaf, sheet < Lat. *fo'lium*, leaf]: in French journalism, the name of that part of the sheet which contains the literary intelligence, criticism, and other similar matter. The feuilleton often contains tales, either complete or serial. Hence a light romance written for a journal is often called a feuilleton.

Féval, fā'vaal', Paul Henri Corentin: novelist; b. at Rennes, France, Sept. 27, 1817; admitted to the bar at his native place, but soon became an author. Among his novels the following have been translated into English: *The Lover of Paris* (1846); *The Duke's Motto* (1863); *The Woman of Mystery* (1864); and *Thrice Dead* (1869). Was made an officer of the Legion of Honor in 1869. D. Mar. 1887.

Fever [O. Eng. *fēfer, fēfor*: Mod. Germ., *Fieber*, from Lat. *febris* > Fr. *fièvre*]: a condition of the animal body characterized by a measurable and continuous elevation of the general temperature. This definition excludes short accessions of heat due to accidental and ephemeral causes, and purely local elevations of temperature, and limits the notion of fever to a state which is a concomitant of disease. In fever the functions of the body are disturbed, and usually in proportion to the variation from the normal heat of the body (37° C., 98·6° F.).

It is not exact to speak as if fever could occur as a distinct and particular disorder, for fever is always and only a condition dependent upon a disorder of some part or system of the body, although certain diseases are commonly called fevers because a rise of temperature is in them a constant symptom, as typhoid fever, scarlet fever, etc.

In the condition known as fever there is a definite order of events, spoken of in medical books as the stages of (1) invasion, (2) domination, (3) decline. In a typical fever the first stage is marked by a sensation of general *malaise*, of bodily as well as mental languor, sometimes of headache, with pains to the back and limbs, loss of appetite, an accelerated and rather small pulse, and great sensitiveness of the skin in the temperature of the surrounding atmosphere, and a *chill* may set in, causing involuntary shaking of parts of the body, with paleness of the surface and a bluish tinge of the nails and lips. This stage, after having lasted a certain length of time, gives way to a sensation of *heat* not merely felt by the patient himself, but also appreciable by others. The skin becomes turgid and congested, feels hot and dry, the pulse remains quick, but is fuller, the respiration is more hurried and irregular, there is general restlessness, the thirst is intense, the appetite is lost, the tongue is coated with a whitish film, the mucous membrane of the mouth and throat is dry, the urine is scanty, of a deeper color, and of a greater specific gravity: and the patient, who during the cold stage could hardly get on clothing enough, wants to free himself from every covering. After this stage of dry heat, the skin breaks out in a profuse *sweat*, the dryness of the mouth and the thirst diminish, the respiration becomes deeper, more regular, and less frequent, the pulse, still accelerated, is full and bounding, the patient grows calmer, and often falls into a sleep, out of which he awakes with a pleasant sensation of well-being, although more or less debilitated.

Not all the symptoms just described must necessarily be present. It is not always that fever is ushered in with a chill. Very often only slight horripilations, goose-flesh, and insignificant rigors precede the development of intense heat, which may pass off, scarcely moistening the skin by sweat. Instead of great muscular pain and a torturing sensation of restlessness, there may be not more than a rather voluptuous feeling of laziness, and, in place of a distressing confusion of ideas, a not unpleasant play of the fancy may exist. The appetite is not always wholly lost, nor is the thirst necessarily great. The pulse, never as slow as in health, either from individual peculiarities or from bodily enfeeblement antedating the fever, or from long duration of the fever, may show great frequency, and yet not denote a very grave febrile state, provided other symptoms are moderate. The symptoms vary, too, in consequence of the influence of local diseases, or according to the duration of the febrile process. With all these variations, producing the most different types of fever, the totality of symptoms so strikingly impresses the mind of even non-professional observers that hardly ever is a mistake made in pronouncing a patient "feverish."

There is one symptom which is never wanting in fever, which can be measured with mathematical exactitude, and which furnishes a standard of comparison between fevers of different degrees of severity: it is the *increase of the temperature* of the body as determined by the thermometer. The thermometer furnishes not only an indication of the progress of any fever, but is a valuable aid in discriminating between different diseases in which fever is a prominent symptom. This is due to the fact that in different fevers there are characteristic alterations of temperature, marked by an orderly progress of elevation or depression, occurring at regular intervals, and rising or falling within definite limits.

In a former edition of this cyclopædia it was stated that the classification of fevers is based partly on scientific, partly on practical, partly on purely arbitrary grounds, and that the principal and really scientific distinction is between *idiopathic* (primary) and *symptomatic* (secondary) fevers, the first class comprising those varieties in which the fever is the only, or at least the first (primary), morbid action, so that local disorders occurring in the course of the fever must be considered as depending upon it. This is not in accordance with the facts of pathology. As stated above, fever is only a symptom, and it is not correct to classify as idiopathic the zymotic or miasmatic fevers, for these are dependent upon disorders of tissues of the body (the blood is technically a tissue) as truly as are those fevers the names of which are derived from the *morbid process* which lies at their root; for example, inflammatory, catarrhal, rheumatic, hectic fevers, or fevers named after the organs whose diseased condition causes them—brain, lung, gastric, and enteric fevers.

An illustration of an inexact term is furnished by the name "bilious fever," which is a condition characterized by more or less depression, sometimes nausea, usually disturbance of the bowels, with coating of the tongue and loss of appetite. It is most common in persons whose skin is of a dusky color, and who are of the brunette type in general. It is so named because it is supposed to be dependent upon an excessive formation of bile. This, however, is not the case.

The name of some fevers is derived from some predominating symptom—e. g. typhus (Gr. τῦφος, stupor), eruptive, break-bone, spotted, scarlet, yellow fever. Sometimes the real or supposed *cause* is made use of to give the name—e. g. malarial, septic, hay, jail, ship fever. The febrile process, while having its stages of rise, height, and decline, does not run through them with an even tenor, but certain oscillations occur, the febrile symptoms showing an exacerbation and a remission every twenty-four hours, or even in a shorter time. The exacerbation in the greatest number of cases sets in in the evening and advances until about midnight, when the remission commences, so that in the morning hours the temperature is at its lowest point for any day. If the temperature never falls to the normal point, the fever is called a *continued* or *continuous* one. If at some time it falls nearly to the normal point, the fever is called *remittent*. If the febrile symptoms disappear altogether, to return on another day, the fever is called *intermittent*. An intermittent fever, in which the fever returns every day, is called *quotidian*; if it return on the third, fifth, or seventh day, and so on, it is called *tertian*; if on every fourth day (1, 4, 7, 10, etc.), it is called *quartan*. A fever lasting with certain well-marked symptoms for several days, then disappearing and returning after a few days' intermission, is called *relapsing* fever.

To understand fully what occurs in fever, conditions would have to be fulfilled which are either totally hidden or obscure, or the realization of which is surrounded by such difficulties that they have become only partially solved. Granted a thorough knowledge of the anatomical structure of the organs and the systems of the body in perfect health; of their chemical composition: their relative and total weight; of the quantity and quality of secretions and excretions; and testing the same individual just emerging from a fever in all these respects—the *ultimate* changes wrought by fever would be apparent.

To understand how these changes have been produced it would be necessary to know the quantity and chemical constitution of solid and liquid food consumed during the fever, the alternation of the circulation, the air inspired and expired, the quantity of force expended by voluntary and involuntary motion, the quantity and chemical composition of all secretions and excretions, and finally, the amount of animal heat generated during the fever. Moreover, to guard against any error vitiating the value of these facts, it would be necessary to eliminate all the influences of local diseases, producing the fever or being produced by it. Moreover, all the above occurrences would have to be gathered, not as a whole, but in parts, in regular intervals, some of them if not hourly at least twice a day, as it is known that periodical fluctuations take place in the physiological state during the night and day. Of all these matters only a very small part has been studied with such frequency and thoroughness that results have been gained which are beyond doubt.

Instead of philosophical speculations and the coining of a more or less ingenious hypothesis, a true scientific method of observation and experiment rules the science of pathology; and if no great advances have been made in clearing up the pathology of fever, it is not altogether because the ways are unknown, but because the means and time to unravel the complex maze of the febrile process are not furnished even to scientific institutions, not to speak of single individuals.

What is known with some degree of certainty is this: that the waste of organic material is not merely owing to a diminished supply of food or to an imperfect assimilation, but that of all organic substances the albumen of the body is disproportionately consumed. This is shown by the fact that more than double the quantity of urea is eliminated than is normal. The quantity of urea can not be increased unless a corresponding decomposition of nitrogenous substances by oxidation takes place. Further, more carbonic acid gas is given off, partly by breathing, partly by insensible loss, than under the same conditions in a state of health. The same is true of water. But neither of these substances is lost in so great a proportion as urea. The coloring-matter of the urine is increased in quantity, indicating disintegration of the red blood-corpuscles and of the muscles. The urine, too, contains a much greater proportion of salts of potash—another evidence of the waste of red blood-corpuscles and muscles. The changes which have been alluded to can not occur except by increased oxidation, and as oxidation is a source of heat, during fever more heat is produced. This increase of heat in the body takes place even during the cold stage, and although the outer parts are colder than they are normally, yet within the cavities of the body by use of the thermometer an increase of heat is demonstrated.

The increase of heat-production in fever is compensated to a certain extent by conduction, radiation, and evaporation from the surface, or by all three combined; but the wonderful regulation by which the body in the physiological state keeps its temperature at about 37° C. (98·6° F.), contracting the blood-vessels of the skin if the surrounding medium is cold, and causing evaporation by sweat if the surrounding medium is hot, is materially perverted in fever.

Limited and fragmentary as is the knowledge of pathology of fever, even less is known of its origin. It appears clear that irritation of the peripheral nerves, as of the intestines or of the skin, may produce impressions upon certain parts of the brain which result in changes in the bodily temperatures, and it seems to be proved that irritation or injury of a definite region of the anterior part of the cortex of the brain has a decided effect upon the process of heat-production, while psychological processes undoubtedly influence it. Fever can also be produced experimentally by injecting septic substances into the blood, and secondary fevers are probably generated in a similar manner, the original disease producing some substance which contaminates the blood.

Pathologists of the humoral school believed that organic and chemical changes in the blood are sufficient so to alter the whole process of nutrition and assimilation that a general disease, called fever, would result. According to their views, the nervous system would be a mere registering apparatus for changes of psychological conditions without originating or influencing them. The more recent opinion is that changes of temperature are brought about largely by the influence exerted upon portions of the nervous system by some irritant—irritants usually reaching these points by way of the blood. Like other functions, that of the production of heat is under regulation by the brain and its nervous prolongations. The most important varieties of fever are described under their several titles.

Revised by CHARLES W. DULLES.

Fever Bush: a handsome shrub (*Benzoin odoriferum*, or *Lindera benzoin*) of the family *Lauraceæ*; common in the Northern U. S. Decoctions of its bark and leaves have been used for aromatic and stimulant drinks in low fevers. Its red spicy berries have afforded a poor substitute for allspice. It is also called spice bush and benjamin-tree.

Feverfew [M. Eng. *fevyrfew* < O. Eng. *feferfuge*, *feferfugia* < Lat. *febrifugia*, the centaury, liter., a *febrifuge*]: a large perennial herb (*Pyrethrum parthenium*) of the family *Compositæ*, resembling chamomile, and a native of Europe, sparingly naturalized in the U. S. There are some fine cultivated varieties, which are prized in the flower-garden. It was formerly much used as a deobstruent, tonic, and febrifuge. A related species yields the so-called Persian insect-powder.

Feverwort, Wild Ipecac, Horse Gentian, or **Tinker's Weed**: a coarse perennial herb of the U. S., the *Triosteum perfoliatum* of the family *Caprifoliaceæ*. Its root is used as a cathartic and emetic. A smaller species, *Triosteum angustifolium*, grows in the Southern U. S.

Few, WILLIAM: U. S. Senator; b. in Baltimore co., Md., June 8, 1748; removed in 1758 to Orange co., N. C., and to Georgia in 1776. He was chosen to the State convention to form a constitution, as also to the assembly, and made one of the council. With the rank of colonel he served in the war of the Revolution; in 1778 he became surveyor-general, and also presiding judge of the Richmond County court. From Jan., 1780, to 1783, he was delegate to the old Congress, and also in 1786; a member of the national constitutional convention in 1787, and of those of the State of Georgia in 1796 and 1798; U. S. Senator from Georgia 1789–93, and then three years on the bench. He removed to New York in 1799, and was afterward in the State Legislature, commissioner of loans, and mayor of the city. D. at Fishkill, N. Y., July 16, 1828.

Fewkes, JESSE WALTER: See the Appendix.

Feyen, fā'i-ăañ, EUGÈNE: genre-painter; b. at Bey-sur-Seille, Meurthe-et-Moselle, France, Nov. 13, 1815. Pupil of Paul Delaroche; second-class medal, Salon, 1880; third-class, Paris Exposition, 1889; Legion of Honor 1881. His pictures of fisher-folk are meritorious, notable for delicate color. Studio in Paris. W. A. C.

Feyen-Perrin, -păr'răñ', FRANÇOIS NICHOLAS AUGUSTIN: genre-painter; b. at Bey-sur-Seille, Meurthe-et-Moselle, France, 1829. Pupil of Yvon and Léon Cogniet; medals, Salons, 1865 and 1874; Legion of Honor 1878. He generally painted pictures of fisher-life, and though his pictures are not without good technical qualities, they are weakly sentimental in expression. *Return of Fisher-girls at Cancale* (1874) is in the Luxembourg Gallery, Paris. D. in Paris, Oct. 14, 1888. W. A. C.

Fez: chief of the three capitals of Morocco and frequent residence of the sultan; 160 miles S. S. E. of Tangier, with which it is connected by only a bridle-path (see map of Africa, ref. 1–B). It is a beautiful and picturesque city from without, but filthy within. It is the commercial center of the country, and has important manufactures of silk, wool, and leather. There are sulphur baths in the vicinity. It was built probably in 793, and was long the capital of the Mohammedan states of West Africa. The Moors considered it the finest city in the world. It was once a great seat of learning, and is still held in great veneration. Pilgrimages were once made to Fez when the road to Mecca was considered unsafe. The Turkish cap or "fez" was, until recent times, made here exclusively. The population is 150,000.

Fezzan, fez-zaan' (anciently *Phasania*): in Northern Africa; between lat. 24° and 31° N. and lon. 12° and 17° E.; bounded N. by Tripoli, and on the other sides by the Sahara. It forms with Tripoli and Barka a province of Turkey. Most of Fezzan is a silent and barren desert with oases here and there. The northern part of the country is covered with bare hills of black quartz sandstone, without rivers and almost without vegetation. The southern part is level land, often consisting of dry sand. Only one-tenth of the soil is cultivable. The climate is in summer extremely hot, and at all seasons very dry. Wheat and barley are cultivated; dates, figs, and lentils are the principal articles of food. Horses and camels are reared, but cattle, and even sheep, are rare. Lions, tiger-cats, and jackals are abundant; also gazelles and ostriches. The inhabitants, whose number is estimated at about 50,000, are a mixed race of Berber Tuaregs, Arabs, and Negroes. They are governed by a sultan, who pays a tribute to the viceroy or *valy* of Tripoli. Murzuk is the capital, and the rendezvous for the caravans coming from Cairo, Tripoli, and Timbuctoo, which occasion a considerable trade.

Fiber, or **Fibre** [from Fr. *fibre* < Lat. *fibra*, fiber, filament]: a delicate, thread-like portion of the tissue of a plant or animal; also a substance composed of such filaments. Man has for ages availed himself of the filamentous character of various parts of plants to make clothing, domestic utensils, parts of instruments of the chase, and shelter for himself and his possessions. The animal kingdom has also been laid under contribution from the earliest times, and even the mineral kingdom contributes, in the substance known as asbestos, a fiber—in the general sense of the word—which has various uses in the arts. The history of the employment of these different materials, their uses, and the details of those processes of manufacture by which they are converted into fabrics for the use of man, belong properly to the different articles in this work in which they are severally described. (See SILK, WOOL, etc.) But the minute characteristics of the principal vegetable fibers, and the points on which their value for particular purposes depends, are most conveniently studied by grouping them under one subject. Anatomically considered, vegetable fibers may be referred to three different sources: viz., (1) plant-hairs, (2) fibro-vascular bundles, or (3) the separate constituents of the latter. (1) The important plant-hairs employed for textile purposes are the long, single cells which are attached to the seeds of certain species of *Gossypium* (cotton). (2) Fibro-vascular bundles are obtained from the stems of monocotyledonous plants, and consist chiefly of long bast-cells, with an admixture of spiral ducts (e. g. Manilla hemp). (3) The principal elements of fibro-vascular bundles of dicotyledons —namely, bast-cells and woody tissue—are used separately as fibers for spinning or for paper-making (e. g. flax and poplar-wood). These structures are cells of different shapes, sizes, and thickness of wall. Although they are derived from sources so different, they possess in common certain chemical and physical properties which must be considered before an examination of individual fibers is undertaken.

Chemical Characters.—The principal material of vegetable tissues consists of cellulose ($C_6H_{10}O_5$, or some higher multiple, $C_{18}H_{30}O_{15}$). This is generally accompanied by an incrusting substance which greatly reduces the flexibility of the fiber. Fibers are freed from this incrusting matter by the careful use of acids, alkalies, and bleaching agents. Cellulose dissolves in an ammoniacal solution of cupric oxide. For an account of other changes produced by chemical agents, see GUNCOTTON, and PAPER.

Physical Properties.—Fibers vary in color, from the snow-white of china-grass (*Böhmeria nivea*) to the grayish black of *Tillandsia*. All vegetable fibers are doubly refringent in polarized light. The conductive power of vegetable fibers for heat appears to be greater in the direction of the length of the fiber than perpendicular to it. The hygroscopic power of fibers is shown in the following table by Wiesner (*Rohstoffe*, § 293):

FIBER.	Percentage of water when air-dry.	Greatest amount of water.
Esparto	6·95	13·32
Belgian flax	5·70	13·90
Cotton	6·66	20·99
Fresh jute	6·00	23·30
Manilla hemp	12·50	about 40·00

Cotton.—Cotton fibers are the hairs which grow upon the seeds of species of *Gossypium*, plants belonging to the mallow family. Five species, now much mixed up, produce most of the cotton of commerce—*G. arboreum, barbadense, herbaceum, hirsutum, religiosum.* In India and China *G. arboreum* and *religiosum* are extensively cultivated; *G. hirsutum* is common in the West Indies; *G. barbadense* and *herbaceum* are those best known in the U. S. The seeds are numerous in the capsule (boll), which splits from the top into three or five parts as the fruit ripens. Each seed is clothed with delicate cells of variable length. Very short hairs are mixed thickly with the longer cells, which are used as fibers. The longer cells vary in length within certain limits in different species; the following measurements by Wiesner are averages:

Gossypium barbadense		3·89–4·05 cm.
"	*arboreum*	2·50
"	*herbaceum*	1·03–1·82 cm.

The cells are slender cylinders, with a slight enlargement a little above the base, after which they taper to the summit. The thin walls collapse and twist as the seed ripens, so that the slender, tapering tubes become spiral bands. The breadth of the flattened cells varies in different species. The measurements (from Wiesner) are given in fractions of a millimeter:

G. barbadense,	0·0192–0·0279,	most common	0·0252
G. arboreum,	0·0200–0·0378,	" "	0·0299
G. herbaceum,	0·0119–0·0220,	" "	0·0189
G. religiosum,	0·0255–0·0400,	" "	0·0333

The spiral is irregular, sometimes turning to the right and then abruptly turning in the opposite direction; occasionally there is simply a folding of one edge of the band over the other. These spirals adapt the cells for spinning. Contiguous fibers cling together slightly by interlocking their spirals as they are drawn out, and this slight grasp is strengthened by torsion of the thread at the spindle. Length of fiber is known in the cotton trade as length of "staple."

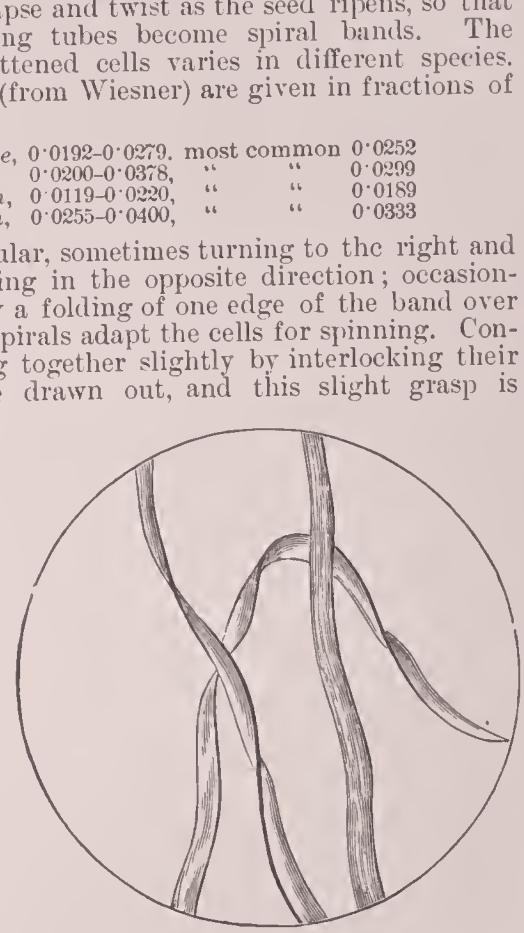


FIG. 1.—Cells of cotton (170 diam.).

Under a magnifying power of 200 diameters the flattened cell, if ripe, exhibits plainly the cell-walls and the space between them, which is filled with air. In exceptional cases the walls are thick, and then the air-space is reduced to a slender dark line. The surface of the wall has a cuticular layer, which may appear unevenly striated, somewhat granular, or nearly smooth. When a cotton fiber is placed in an ammoniacal solution of cupric oxide, the cell-wall dissolves, and leaves the cuticular layer somewhat altered in shape. The same phenomenon is observed in the case of other plant-hairs—for instance, vegetable silk—but never in bast-cells. This use of the solvent serves for the positive discrimination of the textile plant-hairs. The cotton fiber is usually white, but may be tinged yellow (*G. religiosum*). The finer short fibers are frequently colored green (*G. hirsutum*). This becomes rose-red on the addition of dilute acid, but the green color is restored by ammonia. The removal of the cotton fiber from the epidermis of the seed is effected without material injury to the hairs of black-seed cotton by means of the saw-gin. In green-seed cotton the fibers are more closely adherent. The shorter hairs which remain after the ginning are utilized in paper-making. The characters which determine the commercial grade of cotton are length of staple, fineness, and whiteness. In sea-island cotton, always black-seeded (*G. barbadense*), the latter qualities are found combined with great length of staple. The cotton of Louisiana is short-stapled, fine, and white; that from *G. religiosum* (and *G. flavidum*) is short-stapled, fine, and yellow.

Bombax Wool.—The mature seeds of many *Bombaceæ* are packed in their capsules in a mass of silky hairs which have become detached during ripening. These hairs are single cells of brilliant luster and a yellowish-brown color. It can not be spun except when mixed with cotton or other fibers, which it can in no way improve.

Vegetable Silk.—Under this name are grouped the fibers which grow on the seeds of many milkweeds (*Asclepiadaceæ* and the like). The remarkable fineness and luster of these fibers have led to many futile attempts to employ them, either alone or with cotton. The fiber is so weak and brittle that it would be useless for weaving even if it could be spun. A species of *Beaumontia* in India yields a vegetable silk of greater strength and almost pure whiteness. It is used in the manufacture of artificial flowers.

Fibro-vascular Bundles of Monocotyledonous Plants.—New Zealand Flax.—This fiber is obtained from *Phormium tenax*, now extensively cultivated in New South Wales. The leaves yield 22 per cent. of merchantable fiber. The fiber is yellowish, and composed of bast-cells mixed with ducts and cambium-cells. The bast-cells are 0·008–0·0189 mm. broad, and 2·7–5·65 mm. long. These form the raw fiber, which often exceeds a meter in length. New Zealand flax is fitted for cordage by its strength and resistance to the action of water and the atmosphere. According to Labillardière, the absolute strengths of the New Zealand flax, hemp, and flax are in the ratio of 60 : 48 : 34·5; silk = 100.

Aloë Fiber.—This is obtained from tropical species of *Aloë*. The fiber is white, of brilliant luster, and of nearly the same thickness throughout its great length of 20–50 cm. It is made up chiefly of bast-cells 1·3–3·72 mm. long, which do not readily separate from the bundle. The fibers are used in the rough state for cordage. The finest aloë fibers are spun and woven for fine muslins.

Manilla Hemp.—This fiber, known also in commerce under the names plantain fiber, Siam hemp, Menado hemp, and white rope, is obtained from the clasping leaf-stalks of *Musa textilis* of the Philippine islands. The fibers of other species of *Musa* have been employed, notably the plantain and banana. The outer parts yield coarse fibers 7 meters long—the inner, finer, about 2 meters. The fiber consists chiefly of bast-cells 2·7 mm. long and ·029 mm. thick. Manilla hemp is used for cordage.

Agave fiber, from *Agave americana*, now cultivated in many warm climates, is less tough and flexible than Manilla hemp. It is extremely light, and is capable of extensive use in rigging, but it has been more employed as an addition to bristles in the manufacture of brushes. "Sisal hemp" is the commercial name of the fiber of *Agave rigida*.

Cocoanut fiber, from species of *Cocos*, a tropical palm, is known in commerce under the name coir. It consists of the fibro-vascular bundles of the husk of the fruit. It is reddish-brown in color, very strong, and withstands the action of water for a long time. It is regarded by Grothe as the lightest of all fibers which can be used for making cordage. The raw fiber is 15–33 cm. thick, and consists of many structural elements. The bast-cells are the most important. These are from half a millimeter to a millimeter in length, and 0·016 mm. broad. The walls are unequally thickened. Coir is one of the most important vegetable fibers of the tropics. It is used for twine, cordage, tapestry, brushes, coarse paint-brushes, and even machine-belting.

Pineapple Fiber.—The fibers of the leaves of several species of *Bromelia* are employed for textile purposes. *Bromelia karatas*, of South America, yields a whitish, glistening fiber which resembles Manilla hemp, but is coarser, weaker, and less flexible. The fibers are cylindrical and about a meter in length, seldom exceeding 1·2 mm. in thickness. Its constituents are chiefly thin-walled bast-cells, with a few spiral vessels. When carefully prepared the finest fibers can be used for delicate fabrics.

Bast-fibers from Dicotyledonous Plants.—These are the inner layer of the bark. They are long, flexible cells, with thick walls, aggregated with parenchyma in bundles or bands which are separated by very narrow (or in some cases wide) medullary rays.

Flax.—This is the bast-fiber of species of *Linum*, chiefly *L. usitatissimum*, of which there are several varieties. The separation of the bast-fibers of flax, hemp, etc., from their contiguous tissues involves mechanical and chemical manipulations which are elsewhere described in detail. The stems are first subjected in mass to the action of water, either cold or warm. A kind of fermentation ensues, after which the bast-fibers can be separated from the surrounding tissues by mechanical means. The processes are known as "retting" and "scutching." The best results have been reached by what is known as warm-water rotting, followed by the use of a heckling machine, from which, according to the quality of the flax-plant, 15–20 per cent. of pure flax has been obtained. The length of flax fibers thus separated varies from a fifth of a meter to a meter and two-fifths; their width varies from 0·045–0·620 mm. The fibers are made up of regular cylindrical cells which taper toward the ends. The caliber of the cells is very minute, and is often reduced so that it appears a mere dark line. The cells are 2–4 cm. long and from 0·015–0·017 mm. broad. Here and there minute canals are to be detected in the walls, and by crushing the cell-wall exhibits spiral markings. The microscopic appearance of fresh flax bast-cells differs from that presented by manufactured fiber. The thickening layers of the cell-wall are more or less broken, and the cells are covered with dark lines which are nearly parallel to each other, and generally run in the direction of the length of the cell. This appearance is seen under a magnifying power of 200–300 diameters.

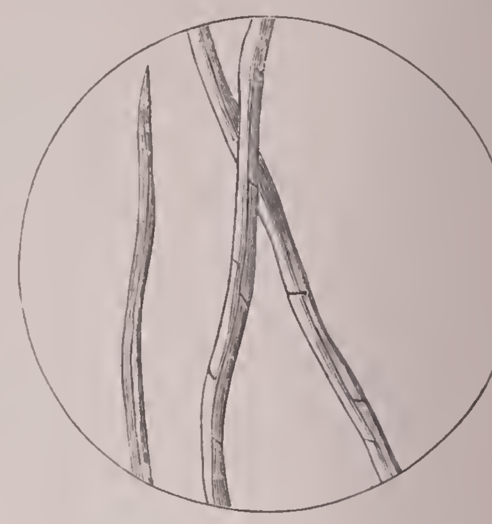


FIG. 2.—Bast-cells of flax (170 diam.).

The best flax fiber is whitish, and this absence of color is secured by the best methods of preparation. Much of the Belgian flax is steel-gray, and that of Egypt is grayish yellow. Flax has a delicate silky luster. The total absence of any luster is an indication that the bast-cells have not been wholly freed from surrounding tissues. Irish, Belgian, and Italian flax is regarded finest. The Irish fiber is very fine, soft to the touch, and strong. Many Belgian varieties are nearly as fine as the Irish, and exceed it in length. The longest fiber comes from Egypt. It is coarse and hard to bleach, but very strong. The use of flax in the manufacture of linen thread and linen fabrics can be traced further back than that of any other textile vegetable fiber. It is spun before bleaching.

Hemp.—This fiber consists of the bast-cells of *Cannabis sativa*, a plant of the nettle family. Hemp fiber is generally longer than flax fiber, sometimes reaching a length of 1 or 2 meters, or even more. Whitish and grayish fibers are best, the greenish come next, and lastly come the yellowish. Hemp fiber, even when finest, contains a mixture of parenchyma with the bast-cells. The latter are not so regular as those of flax. The walls are not always equally thick, but they are in general strongly thickened, and exhibit the canals which have been described under *Flax*. The air-space in the cells equals one-third of the whole breadth of the cell. Wiesner has shown that an ammoniacal solution of cupric oxide serves for the discrimination of hemp from flax. Under the influence of this agent the inner layer separates and becomes much crumpled, while the outer portion of the cell-wall becomes swollen and exhibits a fine parallel marking. Flax and cotton become blue by the action of iodine solution and sulphuric acid, but hemp turns somewhat greenish. The finest hemp is Bolognese, but by far the largest amount comes from Russia. It is not so fine as the hemp from Prussia or Austria. The hemp produced near Strassburg is used for spinning. Hemp is chiefly used for fine and coarse cordage.

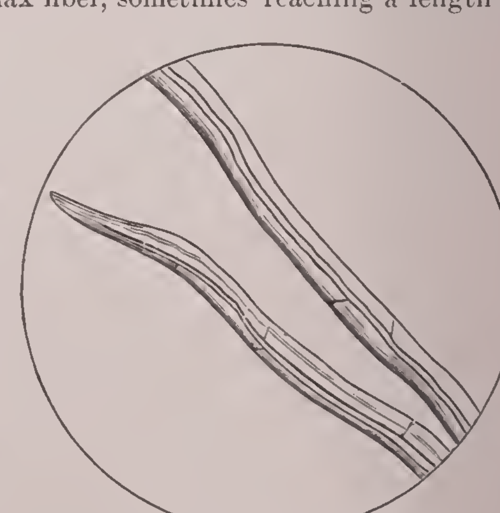


FIG. 3.—Bast-cells of hemp (170 diam.).

Mallow Hemp.—Several plants of the mallow family yield fibers which may be treated of in this place.

Hibiscus cannabinus of India, now cultivated in the West Indies, where it is called *ambaree*, has fibers of unequal length and differing greatly in their thickness. The bast-cells are 4–6 mm. long and ·020–·041 mm. thick.

Sida retusa and other species of *Sida* are much used in India as sources of fibers, which are coarse or fine according to the mode of preparation. The bast is without luster and of remarkable strength. The fibers consist almost wholly of flattened irregular cells, which in other characters much resemble the bast-cells of flax. Sunn hemp is produced from stems of *Crotolaria*, a plant of the pulse family. It is a fine and very strong fiber, only slightly hygroscopic. It is known in India also as Madras hemp. The flattened fibers are striated, and vary in width from 0·02–0·35 mm. Tercum fiber and Jetee fiber are from the stems of plants of the milkweed family.

China-grass and Ramie.—These are from plants of the nettle family—the first from *Böhmeria nivea*, and the second from *B. tenacissima*. China-grass is cultivated in India and Southern China. The bast is very tough, and can be finely divided into minute fibers, which are known as cottonized fiber. It is whiter and more lustrous than ramie fiber, but in other respects does not differ widely from it. *Ramie* is cultivated in China and Japan and in some parts of America. By the "cottonizing" process the fibers are broken up into the bast-cells, which are themselves sometimes broken. It is frequently possible to detect under the microscope traces of the mechanical injuries which they have received in the process. From the coarser fibers cordage is made, but from the finer the so-called *grass-cloth* or *grass-linen* is woven. The manufacture was long confined to India and China, but it has been undertaken in Germany as well.

Jute is the fiber of several Indian species of *Corchorus*, a plant of the linden family. *Corchorus capsularis* is the species most commonly employed in cultivation. In warm countries the culture of jute presents few difficulties. The seed is sown in April or May; in June or July the plant is in flower; in September or October the fruit is ripe. The strength and flexibility of this fiber, like those of flax, hemp, and ramie, diminish at the time the fruit matures. The bast-cells at that time become woody and more brittle, so that it is always desirable to cut the stems before the ripening of the fruit. The yield of jute is said to be from two to five times as great as that of hemp or flax. The stalk is 3 to 4 meters high. The fiber of jute is very silky, slightly colored, and composed almost wholly of bast-cells, which are cylindrical, somewhat flattened, or prismatic. The cells are 0·8–4·1 mm. long, and 0·016 mm. thick. The most striking peculiarity of its microscopic structure is the total lack of parallelism between the inner and outer surfaces of the wall. At many points the cell-wall is much thickened, while in others it is as thin as in vegetable silk. The same unevenness is seen in a few other fibers, but not in flax or hemp. Jute in its finest state has such a brilliancy of luster, and takes colors so well, that it has been much used to mix with silk. Much has been employed as a substitute for human hair in the manufacture of chignons, etc. Of late it has found an extensive use in papermaking. Jute is extensively exported from Calcutta, and is used chiefly in the manufacture of bagging. The term *gunny bagging* (*goni*, a Madras word) was applied not only to this, but to coarse fabrics made out of sunn, *Crotolaria juncea*. Much jute is brought into the market in the form of jute butts, in which state it is taken by the papermakers. A fiber much like jute, and frequently mixed with it, is obtained from *Abelmoschus* (*Hibiscus*) *tetraphyllos*, a plant of the mallow family from India. The bast-cells are 1–1·6 mm. long, and about 0·016 thick. See JUTE.

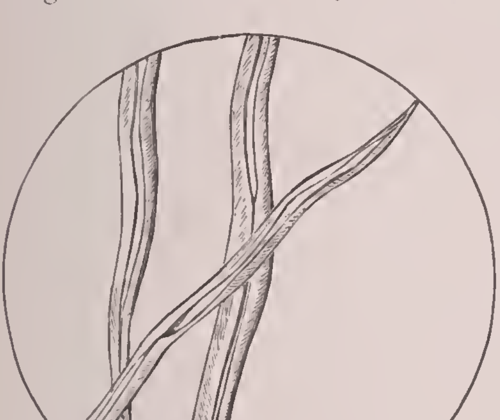


Fig. 4.—Bast-cells of jute (170 diam.).

Esparto Fiber.—This is obtained from the stems and leaves of *Macrochloa tenacissima*, a grass of Southwestern Europe. The fiber has been employed in the manufacture of coarse twine, but is now used wholly for papermaking.

Any of the fibers which have been spoken of can be used in the manufacture of paper, but only a few of them can be economically employed for this purpose at first hand. The fibers first serve in cordage or in woven fabrics, and then are turned over in the form of rags to the papermaker. Fibers for paper must be waste products or very cheap raw material (for instance, wood-tissue) which can be economically worked. *Zizania* (wild rice), *Phragmites* (reed), and the straw of cereals are used in the manufacture of different grades of paper.

Paper Mulberry.—This plant, which belongs to the fig family, furnishes the fibers of which the tapa cloth of Polynesia and the common paper of Japan are made. The inner bark is beaten to a pulp and spread out in thin layers. Much of the Japanese paper contains some vegetable mucilage by which the texture is rendered firmer, but in general the tissues cohere without the addition of any size.

Bast Tissue.—The bast of the linden and some other exogenous plants may be separated from the stem in broad and thick bands, which can be split up into thin ribbons. From these thin bands the coarse Russia matting is made.

Bast of the Linden (*Tilia parvifolia* and *T. grandifolia*).—Stems 30 to 40 cm. high are best for the purpose. From these stems strips 6 to 7 cm. broad can be taken. Their ultimate bast-cells are very thick-walled, and sometimes much widened in the middle. Cuba bast, used for tying up packages of cigars, is from *Paritium tiliaceum* and *elatum*, plants which may be referred to the genus *Hibiscus*, of the mallow family. *Lagetta lintearia*, the lace-bark tree, yields a delicate but strong white bast which has open meshes like coarse lace. *Daphne cannabina*, another plant of the same family (*Thymelaceæ*), has a tough, fibrous bast, which is employed in India for the manufacture of cordage and paper.

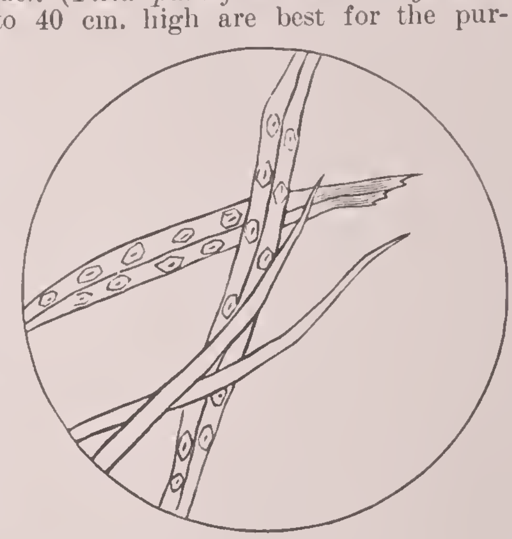


Fig. 5.—Spruce fibers (170 diam.).

Woody Fibers.—These are not used for spinning, but they are finding extensive application in papermaking, and their characters should now receive attention. Two important woods are selected, poplar and spruce, both of which are disintegrated either by mechanical means or by chemicals. In some mills the wood is boiled under pressure, with or without the presence of alkalies, after which it is easily broken down into its cells. In the Voelter process the wood is simply ground upon a rough surface, and the fibers are sufficiently fine for papermaking. The processes will be described in the article PAPER.

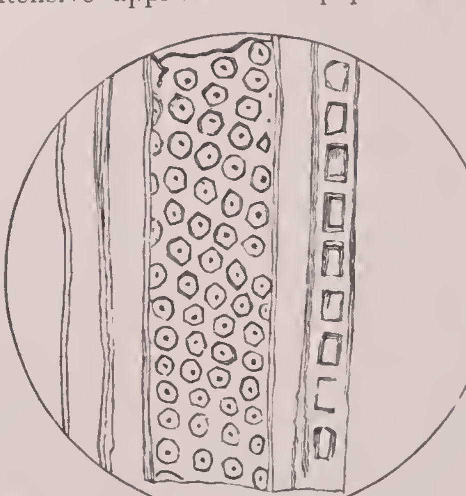


Fig. 6.—Poplar fibers and pitted vessel (170 diam.).

Chemical Tests for Vegetable Fibers.—A. Iodine in solution, followed by sulphuric acid. 1. Blue color: cotton; raw flax; cottonized china-grass and ramie (sometimes reddish to blue); raw hemp, greenish blue to pure blue. 2.

Yellow to brown: raw jute; raw esparto; bromelia; aloë and New Zealand flax.

B. Ammoniacal solution of cupric oxide. 1. Dissolves the cellulose: cotton, the cuticular layer remaining; cottonized china-grass and ramie; raw flax; hemp; sunn. 2. Colors the fiber blue, and causes it to swell up: raw jute; New Zealand flax; aloë; bromelia. 3. Simply colors the fibers: vegetable silk, blue; esparto, green.

C. Sulphate of aniline. Almost without effect on cotton, raw and cottonized china-grass and ramie; raw flax and New Zealand flax. Produces change of color in raw jute (gold yellow), raw hemp (light yellow), esparto (bright yellow), aloë and bromelia (gold yellow).

Microscopical Discrimination of Fibers as used.—Fibers of a single cell: cotton, vegetable silk, bombax wool (plant-hairs), cottonized ramie and china-grass (isolated bast-cells). Groups of cells chiefly bast: raw jute, flax, aloë. Groups of cells chiefly bast, with traces of parenchyma of the bast: raw sida, abelmoschus, and hemp. Groups of bast-cells mixed with ducts; New Zealand flax, Manilla hemp, esparto, coir. E. M. SCHAEFFER.

Fi'brin [from Fr. *fibrine*, deriv. of *fibre* < Lat. *fibra*, fiber]: an organic substance formed from the blood and lymph. From the former it is obtained in the proportion of two or three parts per thousand; in the latter in smaller quantity. Fibrin itself does not exist in the blood, but certain elements which together make fibrin do. These "fibrin factors" are increased in inflammatory conditions, and therefore the blood clots easily—a blood clot being largely fibrin. (See COAGULATION.) In wasting conditions fibrin factors are decreased, and clotting is slow.

Fibrin may be extracted from freshly drawn blood by whipping it with a bundle of twigs, to which, as it coagulates, it adheres. After washing, the coagulum presents a white, tough appearance, and upon placing it under the microscope it is found to consist of colorless and elastic filaments of considerable length, crossing each other in every direction, so as to form an irregular network. Within a few minutes after blood has been taken from the body it commences to lose its fluid condition, gradually becoming more and more solid until its coagulation is complete. It is then said to be clotted. The blood clots in the interior of the body after death; also during life when effused into the tissues, and also in a blood-vessel itself when a ligature is placed around it. This change depends wholly upon the presence of fibrin, for after its withdrawal the blood remains fluid indefinitely. With regard to the exact nature of coagulation there are many theories, but nothing is definitely known.

This clotting of the blood is of the utmost importance in the preservation of life. When a blood-vessel is wounded or cut across, the fibrin of the blood which is poured out coagulates upon the edges of the vessel, forming a plug, so that no more blood can escape. If it were not for this spontaneous coagulation, it would be impossible ever to arrest hæmorrhage. See BLOOD. Revised by WILLIAM PEPPER.

Fibrous Tissues: a name applied to a group of the connective tissues, and of great importance as structural elements. They are generally assigned to two groups—the white and the yellow fibrous tissues, the former found in tendons, fasciæ, and other unyielding parts, the latter elastic and found in many organs, notably in the middle coat of the arteries. Fibrous tissues, though so important to animal life, always play a merely mechanical part. Sparingly supplied with blood-vessels and nerves, they are not highly vitalized and have no active functions. They are composed of an albuminoid substance, which is changed into gelatin by boiling. Microscopically, fibrous tissue consists of a more or less dense or loose mesh of fibers with here and there a cell, the latter being of various shapes, sometimes round, again spindle-shaped, or in other cases star-shaped or stellate. White fibrous tissue exists also in many neoplasms, constituting fibromata or fibroid tumors.

Revised by WILLIAM PEPPER.

Fibro-vascular Bundles: See FIBER.

Fib'ula [=Lat. *fi'bula*, clasp, buckle, for **fivi'bula*, **figui'-bula*, deriv. of *fi'gere*, fix, fasten]: in the vertebrate skeleton, the outer of the two bones of the leg between the knee and the ankle, the inner bone being the tibia. In man the fibula is much smaller than the tibia, and does not quite reach the knee-joint. Its upper extremity is the styloid process; its lower, the outer malleolus. It is developed from three centers, and is regarded as the homologue of the radius in the upper extremity.

Fichet, fee'shā', GUILLAUME: educator; b. at Aunay, near Paris, France, early in the fifteenth century; was in 1467 rector of the University of Paris, teaching at the same time rhetoric, theology, and philosophy. He was employed by Louis XI. in making peace with the Duke of Burgundy, and was the patron by whose influence the first printing-press was brought from Germany and set up in the Sorbonne at Paris. Among the first books printed in France were his *Rhetoricorum Libri tres* (probably 1470) and *Epistolæ, in Parisiorum Sorbona* (1471). Fichet afterward held office at the papal court of Sixtus IV. The date of his death is unknown.

Fichte, fich'te, IMMANUEL HERMANN, von: son of the great Fichte; b. at Jena, July 18, 1797, and educated at Berlin, where he studied philology. He was early attracted to philosophy, however, especially by the ideas of his father, and made a comprehensive study of its history. He also heard Hegel's lectures, but he is said to have felt rather disgusted at them, and in his own philosophical writings the opposition to Hegel is often sharp and pointed. He spent the earlier part of his life as a teacher. In 1836 he was appointed Professor of Philosophy at the University of Bonn, and from 1842 to 1863 occupied the same office at the University of Tübingen. In 1863 he retired to private life in Stuttgart. His literary activity was very comprehensive and very prolific. The most important of his works are *System der Ethik* (1850–53); *Anthropologie, neubegrundet auf naturwissenschaftlichen Wege* (1860); and *Psychologie als Lehre vom bewussten Geiste des Menschen* (1864). One of the most interesting of his many essays and speeches is that with which he opened a meeting of philosophers at Gotha in 1847, *On the Philosophy of the Future*. He also wrote on politics, *Grundzüge zur Entwickelung der künftigen deutschen Reichsverfassung* (1848), and on theology, *Die speculative Theologie* (1846). I. H. v. Fichte taught that the world was created by God; he became a convert to Spiritualism. In 1867 he was ennobled. D. in Stuttgart, Aug. 8, 1879.

Fichte, JOHANN GOTTLIEB: the second of the four greatest philosophers of Germany; b. at Rammenau, in Upper Lusatia, May 19, 1762. He was of Swedish descent, and his father was a ribbon-weaver. In his earliest youth he exhibited the moral characteristics that appeared subsequently in the stern outlines of his philosophic system. When he was in his ninth year his excellent memory attracted the attention of the Baron von Miltitz, who interested himself in his education, and placed him successively in the family of a clergyman at Niederau, at the town-school of Meissen, and at the Princes' School of Pforta (1774–80). At the latter place he became acquainted with the writings of Goethe, Wieland, and Lessing. The latter writer exercised an overpowering influence on his mode of thinking and his literary style. He studied theology at Jena and Leipzig, and began to grapple with the problems that form the center of his philosophic system—those of free will and necessity. At this time he studied the systems of Spinoza and Wolff, and adopted a fatalistic view of life. While acting as family tutor in Zurich (1790) he made the acquaintance of Johanna Rahn, niece of the poet Klopstock, whom he subsequently married. Returning to Leipzig in 1790, he began the study of the Kantian critiques, which had been published, the critique of *Pure Reason* in 1781, of *Practical Reason* in 1788, and that of the *Judgment* in 1790. He now found a new world, and began to live a higher life. He saw free will to be the highest principle, and his fatalistic theories crumbled away at once. He visited Kant, and presented as his letter of introduction the manuscript of a *Critique of all Revelation*, a work composed in five days. It won him Kant's respect and esteem, and on its anonymous publication was taken for an original work of Kant by the philosophic public. Fichte, being announced as its author, found himself at once in the foremost rank of philosophers. After his marriage in 1793 he published a work in which he attempted to justify the French Revolution, and by this brought upon himself the suspicion of the German governments. Nevertheless, in 1794 he was called to the chair of Philosophy in Jena, to succeed Reinhold, and there came into personal contact with Goethe, Schiller, Wieland, Herder, Humboldt, and Jacobi, and carried on an extensive correspondence with Reinhold, Schelling, Tieck, Novalis, and the Schlegels. Fichte here elaborated the great central work of his system, in which he attempted to demonstrate the basis of the Kantian system by an *Analysis of Consciousness*. Kant had borrowed his categories from the traditions of formal logic, and thus, while he combated dogmatism, had grounded his system on a dogmatic basis. Fichte sought to correct this by supplying a strict deduction of the categories from pure consciousness, and thus to place philosophy forever beyond the reach of skepticism, and make it rival geometry in the certainty of its results. His *Science of Knowledge* (*Wissenchaftslehre*) appeared in 1794. Goethe, who had read it sheet by sheet as it passed through the press, wrote him: "In my opinion you will confer a priceless benefit on the human race, and make every thinking man your debtor, by giving a scientific foundation to that upon which nature seems long ago to have agreed with herself." It was the first attempt in the history of human thought to unfold dialectically from the Ego the *a priori* conditions of all knowledge. It was at once adopted by the leading thinkers of the Kantian school. In an essay *On the Ground of our Faith in a Divine Government of the World*, which he published in his *Philosophical Journal* in 1798, he used language in speaking of the moral order of the world implying its equivalence to the idea of God, and thus aroused the charge of atheism against him. This, strengthened by the prejudice created by his work on the French Revolution, resulted in his dismissal from his professorship, notwithstanding a vigorous self-defense. To add to his misfortune, Kant at this time saw fit to publish his disclaimer of Fichte's system as a true interpretation of his own. He declared that in his opinion the *Science of Knowledge* was an altogether faulty system, chimerical and ephemeral. Refused protection by neighboring states, but assured of toleration by Frederick William III. of Prussia, he repaired to Berlin, and came into intimate association with Schleiermacher, Frederick Schlegel, Novalis, Tieck, Schelling, and others. Here he published several eloquent popular expositions of his system, the most prominent of which are the *Destination of Man* (1800); *The Sun-clear Report to the Public upon the True Nature of the Latest Philosophy—an Attempt to Force the Reader to an Understanding of it* (1801); *The Way to the Blessed Life* (1806). An outline of the philosophy of history appears in his *Characteristics of the Present Age* (1806). In his *Addresses to the German Nation* he took a bold, patriotic stand against Napoleon (1808). He became rector of the University of Berlin upon its establishment, and exerted a powerful influence upon its constitution. The new career opening to him after the downfall of Napoleon was cut short by his death from typhoid fever on Jan. 27, 1814.

As a philosopher, Fichte's position is that of the immediate successor of Kant and the completer of the critical system. Kant had endeavored to obtain a critical insight into the nature of knowledge. It was for him the product of two factors—the Ego, or subject, and things-in-themselves. He endeavored to determine accurately the value of the subjective coefficient of our knowledge. The intuitions of Time and Space, and the categories of Quantity, Quality, Relation, and Modality, were found to be the results of the spontaneity (or original action) of the Ego; and these results formed the subjective coefficient of knowledge. Kant did not show how these determinations arise in the spontaneous activity of the Ego; he only inferred that they did thus arise from the demonstrated impossibility of their arising from experience. They were logical conditions of all experience whatsoever, and were presupposed by experience, instead of derived from it. The most obvious difficulties of Kant's theory were removed by Fichte's science of knowledge. They were two: 1. Kant held that the subjective factor of knowledge included the general forms or laws (Time, Space, Causality, etc.), while objective things *per se* furnished the contents of sensation, or in other words affected the sensory. But *to affect* is *to cause*, and hence Kant, while he denied all objective existence to the subjective factor of knowledge, was obliged to apply the category of causality to things in themselves, in order to justify their necessity in his theory. Thus his subjective coefficient belonged also to his objective coefficient of knowledge. Fichte avoided this glaring inconsistency by showing that the activity of the Ego furnishes the groundwork of the objective. In ordinary consciousness this phase of the activity of the Ego is not perceived, but by disciplined reflection the mind may acquire the power of seeing the mental genesis of the ideas of Time and Space and of the laws of Causality, Substantiality, etc., and the resulting objectivity which is given to the mere subjective feeling which is the basis of all sensation. 2. Kant's illogical attempt to destroy dogmatism by the critique of *Pure Reason*, as well as skepticism by the critique of *Practical Reason*, has been mentioned. He had not deduced the necessary basis of his categories, but had dogmatically assumed them from logic, without proving them, and hence had left his philosophy open to skepticism. Fichte made a searching analysis of Consciousness, and, starting from the self-identity of the Ego = Ego, or A = A, and proceeding to the self-distinction of the Non-ego not = Ego, or — A not = A, he reaches the idea of limitation or division of the totality by mutual exclusion of the self and the not-self. Thus the first analysis shows the genesis of the categories of Quality, Reality, Negation, Limitation. Pursuing this subtle psychological analysis, he arrives at the other categories, and establishes the fundamental distinctions between realism and idealism, between theoretical and practical. The most wonderful characteristic of this psychological analysis—which is valid for all time, although Fichte's concrete applications of his philosophy to the worlds of nature and history lack value by reason of his failure to study each department in its detailed developments—consists in his demonstration of the successive additions made by reflection in the endeavor to become self-conscious. For instance, in order to be conscious of feeling, the mind thinks it under the form of time; to be conscious of feeling *and* time, it thinks it under the form of space; to be conscious of the latter, it thinks the object under the form of causality. Thus it successively recognizes its own phases of formal activity as conditions of objectivity, and adds these, one after the other, to its sensation, and thereby arrives at the perception of an object in space which affects the organ of sensation. This process is present in all perception of external objects, but is rapid and unconscious. As with Kant, so with Fichte, the greatest stress was laid on the free will and the moral aspect of human nature.

Fichte's complete works were collected and edited in eight volumes by his son in 1845–46. Access to his system through English translations is now quite adequate. The *Life of Fichte* and his popular writings, including *The Nature of the Scholar*, *The Vocation of the Scholar*, *The Destination of Man*, *Characteristics of the Present Age*, *Way toward the Blessed Life*, *Outlines of the Doctrine of Knowledge*, were published in London, translated by William Smith (1848–49). *The Destination of Man* was also translated by Mrs. Percy Sinnett (London, 1846), and a portion of it by one of the contributors to *Hedge's German Prose Writers* (New York, 1856). The *Science of Knowledge* (ed. of 1794) and *Science of Rights* were translated by A. E. Kroeger (Philadelphia, 1868–70). In the *Journal of Speculative Philosophy* have appeared (*a*) *The Introduction to the Science of Knowledge* (ed. of 1794), (*b*) *Criticism of Philosophical Systems*, (*c*) *Sun-clear Statement*, (*d*) *New Exposition of the Science of Knowledge* (1801), (*e*) *Facts of Consciousness*. See articles on KANT, SCHELLING, HEGEL, LEIBNITZ, and PHILOSOPHY. WILLIAM T. HARRIS.

Fichtelgebirge, fich'tel-ge-beer'ge [Germ.; *fichtel*, dimin. of *fichte*, pine + *gebirge*, collect. of *berg*, mountain]: a short but broad range of mountains, covered with firs and pines, on the northern frontier of Bavaria. They are not remarkable for their height, the highest peak, Schneeberg (Snow Mountain), rising only 3,461 feet, but by reason of their central position they form the nucleus from which all the chief mountain-ranges of Germany diverge, and they separate the affluents of the German Ocean and the Black Sea, the Naab descending from them on the S. to the Danube, the Main on the W. to the Rhine, the Saale on the N., and the Eger on the E. to the Elbe.

Fici: plants of the genus FICUS (*q. v.*).

Ficino, fee-chee'nō, MARSIGLIO (*Ficinus*): reviver of Platonic philosophy in Italy; b. in Florence, Oct. 19, 1433; d. at Careggi, Oct. 1, 1499. When a youth he was selected and carefully educated by Cosimo de Medici with a view to placing him at the head of a proposed academy for the cultivation and dissemination of Platonic philosophy. The zeal of Cosimo for Platonism had been kindled by the enthusiasm of a learned Greek—George Gemistus Pletho—who had come from Constantinople with John Palæologus II. to the Council of Florence on the mission which resulted in the union of the churches of the East and West, in 1438. The academy which was founded in 1460 became in after years an asylum for the learned Greeks who had fled to Italy on the capture of Constantinople by the Turks (1453). About this time the invention of the art of printing contributed the necessary means for the rapid spread of classic study, by multiplying and rendering accessible the originals and translations of the same. Ficino translated into Latin the entire works of Plato (1484) and Plotinus (1492), accompanying them with a more or less complete commentary. Besides these, he made translations of many of the works of Proclus, Jamblichus, Porphyry, Dionysius Areopagita, Hermes Trismegistus, Alcinous, Speusippus, and Xenocrates. His translations are still of some value in restoring the original text, as it seems that he had before him manuscripts now lost. His Latin is pure and perspicuous. His work on the Platonic theology (18 volumes; 1482) treats of the nature of the soul, of spirits, and of God. It is especially devoted to the proofs of immortality and the refutation of the Averroistic doctrine of the World-Soul or Mundane Intelligence, which makes the latter to be immortal and the particular soul to be perishable, being cognizant of universals only through participation in the higher intelligence. The most important feature of the philosophy of Ficino is his claim to harmonize Platonic idealism with Christian doctrine. This gave rise subsequently to a school of mystics which numbers Pico of Mirandola, Reuchlin, Agrippa of Nettesheim, Patritius, Telesius, Ramus, and others. The supposed connection of Neoplatonism with Jewish mysticism through the Cabbala, and the discovery of a profound esoteric doctrine beneath the letter of the Bible, stimulated the enthusiasm of its votaries. Freedom in philosophy begins with the conflict of authorities, as Gibbon remarks. The conflict between the schools of Platonism and Aristotelianism at that time prepared the way for the original thinking of the following centuries. Ficino, with Bessarion before him and Pico after him, stands opposed to Pomponatius, the reviver of Alexandrian Peripateticism. The collected works of Ficino (not including the translations of Plato and Plotinus) were published at Basel in 2 vols. (1561–76); revised with additions, 2 vols., Paris (1641). Cf. J. A. Symonds, *The Renaissance in Italy* (ii., p. 324 ff.). W. T. Harris.

Revised by Alfred Gudeman.

Fick, Adolf Eugen, M. D.: physiologist; b. Sept. 3, 1829, in Cassel; educated at Universities of Marburg and Berlin; tutor and professor University of Zürich, 1852–62; Professor (extraordinary) of Physiology University of Würzburg, 1862–68, full professor since 1868. Author of *Lehrbuch der medizinischen Physik* (3d ed. 1885); *Anatomie und Physiologie der Sinneswerkzeuge* (1864); *Compendium der Physiologie* (4th ed. 1891); *Mechanische Arbeit und Warmeentwickelung bei der Muskelthätigkeit* (1882); has contributed papers to the leading German scientific journals.

Fick, August: philologist; b. at Petershagen, near Minden, Germany, May 5, 1833; studied philology at Göttingen, and remained there as teacher in the gymnasium, and later as professor in the university, till 1888, when he became professor in the University of Breslau. His most important work is *Wörterbuch der indogermanischen Grundsprache* (1868), which was republished (1870) as *Vergleichendes Wörterbuch der indogermanischen Sprachen* (4th ed. 1891–93). He has also published *Die Homerische Odyssee in ihrer ursprünglichen Sprachform wiederhergestellt* (1883), a similar edition of the *Iliad* (1885), and the poems of Hesiod (1887). His works, generally marked by independence and originality, are always rich in valuable suggestion even when the main thesis fails to carry conviction. B. I. W.

Fiction [from Fr. *fiction* < Lat. *fictio*, a shaping, making, pretending, deriv. of *fin'gere*, shape, feign (whence *figu'ra*)]: in law, in its ordinary meaning, an assumption that a thing is true which is either not true or which is as probably false as true. Best, an author on *Presumptions*, distinguishes it from a presumption, a mere rule of law established for the purpose of reaching a certain conclusion, though it may be arbitrary, which is based on public convenience or on the difficulty of arriving at the exact truth. Thus the rule that a child under seven years of age can not commit a felonious crime is a conclusive presumption, rather than a fiction. Some writers—as, e. g., Maine (see his work on *Ancient Law*)—use the word "fiction" in a broader sense, to signify any assumption which conceals, or affects to conceal, the fact that a rule of law has undergone alteration, its letter remaining unchanged while its operation is being modified. From this point of view fiction is a powerful agency in the improvement of law. By means of it new views more adapted to the age are introduced under color of observance of ancient forms. The agencies causing the progress of jurisprudence are fiction, equity, and legislation. Among these fiction has played no unimportant part. In some instances courts have even, by means of it, subverted the will of the legislature. A striking instance of this intentional employment of fiction is found in the early English statute of entailments. The history of this subject is so illustrative that it will be stated with some fullness. It is a well-known rule of English common law that a conveyance of land "to A and his *heirs*" gives him the complete ownership and power of disposal of the property. If, however, the words "*heirs of the body*" were used, instead of "heirs," the effect would be different. Such language points only to descendants; and as there might be none, the estate was deemed to be a conditional one. If "heirs of the body" should come into existence, the condition on which the estate was given was deemed to be performed, and the title of A for certain purposes became absolute. For example, he could sell, and thus cut off all claim on the part of his descendants, or he could forfeit the property by his treason, or encumber it by his voluntary act. If none of these acts were done, the estate would pass to surviving heirs of the body, and if there were no such persons, would revert to the original grantor.

The English landed proprietors being dissatisfied with this result, through their influence in Parliament caused a statute to be passed in the reign of Edward I. (13 Edw. I., c. 1) which was designed to prevent it, and to vest the ownership in A in the case supposed, and at the same time deny to him the power to sell or to encumber the property. The intention was that he should use it as owner, fell trees, mine, and do other proprietary acts, while at the same time the property should descend according to the line prescribed in the terms of the gift. From this violation of a cardinal rule of ownership mischievous consequences soon developed themselves. Creditors and purchases were defrauded, lessees were deprived of their leases, for the tenant in possession could make no deed, mortgage, or lease which should outlast his own life, though he appeared to all observers to be the owner. . Records of title were unknown, so that fraud was easily practiced by one who had all the outward badges of ownership. This state of things was endured for a long period, the nobility being unwilling to repeal a law which tended so strongly to the preservation of their estates.

In the reign of Edward IV., after the lapse of nearly two hundred years, the courts allowed a fictitious legal proceeding to be gone through with, which was declared to have the effect to destroy the entailment, and to enable A in the case supposed to become absolute owner. It was a pure fiction, called a "common recovery," and so understood by all parties to it. It was a fictitious lawsuit with regular and formal parties, and its effect was to destroy the entailment, and vest an absolute title in the first person named in the entailment (A). The rule soon became so perfectly settled that it was impossible for a conveyancer to frame a regular entailment without having it subject to this mode of disencumbering the title, so that a "common recovery" became a mere mode of conveyance. In later times the fiction had become so transparent and so cumbrous that the Parliament substituted in its place a mere deed of conveyance, known as a "disentailing deed" (3 and 4 William IV.; c. 74). The case is of interest and value as showing how the fiction, after being allowed for a time, is ultimately recognized as a change or modification of law, and tends to assume the form of a precise provision by means of a statute.

There are many fictions of law regularly resorted to, and having a powerful influence on the administration of justice. It is a cardinal maxim that a legal fiction must be consistent with equity. This doctrine has not been universally followed, particularly in the so-called doctrine of "relation." The meaning of that doctrine, so far as it refers to time, is that in some cases, when an act is done on a particular day, it shall be considered for legal purposes as being done on some earlier day. The act is then said to "relate back" to that prior day. One mischievous consequence of this rule was that if a law was passed during a session of Parliament, it "related back" to the first day of the session, although weeks or months might have elapsed. By this vicious retrospection an act which was perfectly lawful when committed might be treated as a crime. This result was done away with by the statute of 33 George III., c. 13, which enacted that the time when an act receives the royal assent shall be the date of its commencement, unless some other provision is made by law. The same rule prevails in the U. S. The doctrine of "relation" is resorted to in bankruptcy, referring the effect of the decree back to some date earlier than that of the commencement of the proceedings. It is also used in many other cases, not only as to time, but as to place, person, or thing, and in general is made to work consistently with right and justice. An instance of it may be noticed. Should a person deliver a deed conditionally, or in *escrow*, and subsequently, between the time of the first and the ultimate delivery, become disabled to convey, the law will refer the transaction back to the first delivery, for the purpose of upholding it. In other aspects of the case the conveyance would only take effect from the delivery transpiring after the condition had been performed.

Another instance of a fiction is the legal rule that "the law regards no fraction of a day." By means of this theory a person born on the seventh of the month becomes of full age twenty-one years later on the sixth. The fiction, however, gives way where justice requires that a distinction should be taken between two acts done on the same day. In this case a single moment may be decisive, as where two or more conveyances are left for record on the same day by parties having antagonistic interests.

Many attempts have been made to classify fictions, but without much practical success. They are said to be limited by three principal rules: *First*, the fiction must have the semblance of truth: that which is impossible is not to be feigned. *Second*, it shall not be allowed to work an injury. *Third*, it is only to be resorted to to accomplish the end for which it was introduced. To that extent it can not be contradicted; beyond that it may be impugned. "The law," says Gould, in *Lord Raymond's Reports*, 516, 517, "does not love that rights should be destroyed, but, on the contrary, for the supporting of them invents notions and fictions." When they are urged to an intent and purpose not within their reason and policy, a party injuriously affected by them may show the truth. T. W. DWIGHT.

Fiction: in literature. See NOVEL.

Fi'cus [Lat., fig > O. Fr. *figue*, whence Eng. *fig*]: a genus of plants belonging to the *Artocarpeæ*, or breadfruit family, in which it is associated with the breadfruit of the Pacific, the jack of the Indian Archipelago, the mulberry, the Osage orange of the U. S., and the upas-tree of Java; also, any plant of this genus. The common fig-tree (*Ficus carica*) is the most valued representative of this genus. (See FIG.) Many trees of the family yield a remarkable milky juice, which, inspissated, forms the caoutchouc of commerce. The original india-rubber plant, or *Ficus elastica*, of Java, is one of these. The celebrated banyan-tree (*Ficus indica*) of India yields the well-known resin gum-lac. Several of the *Fici* have poisonous qualities; as, for instance, the *Ficus toxicaria*, a native of the Malay islands. One of the most remarkable species is the peepul or BO-TREE (*q. v.*).

Fiddler Crab: See CRAB.

Fid'ei Commis'sum [Lat., committed to one's trust]: a species of trust existing under the Roman or civil law which was employed to effect the testamentary disposition of property to certain persons who by law were incapable of receiving it by direct device or bequest. Exiles, strangers, unmarried persons, those who had no children, and some other classes of persons were under this disability, and whenever a testator desired to evade this law and leave his property to one thus debarred, he selected some person as heir or legatee who was not incapacitated from taking; annexing a request to the gift that he who was thus constituted a recipient of the property should hold what he received in trust for him who was intended as the real object of the testator's bounty. When this form of trust was first adopted there was no means by which the duty imposed upon the immediate donee could be enforced against him. Its fulfillment depended entirely upon his good faith and honor. From this circumstance the trust received the name of *fidei commissum*. In later times, however, to prevent the frauds which were sometimes perpetrated by failure to fulfill such trusts, laws were enacted rendering their execution compulsory. In the time of Justinian a law was adopted by which a trustee could be compelled to disclose under oath the fact that a trust had been committed to him. From *fidei commissa* was derived the doctrine of uses in the English law. See the article USES.

Fide'næ: an ancient Latin city on the left bank of the Tiber, 5 miles above Rome. Livy erroneously calls it an Etruscan city. In Rome's early days Fidenæ was her powerful rival and enemy, but it declined as Rome increased, and before Cicero's time was an insignificant village, important only for its tufa quarries.

Fi'des [Lat., Faith (personified)]: in the religious system of ancient Rome, the personification of good faith or honor, and, as a quality fundamental to all social organization, Fides was represented as one of the oldest divinities, older even than Jupiter. In harmony with this conception, her shrine, the temple of Fides Publica, was reckoned among the oldest at Rome. She was especially revered as a goddess of international relations, and her temple was a depository of documents relating to such affairs. Represented variously; most commonly, however, in the older period as a matron bearing a wreath, carrying ears of corn and a calathus. G. L. HENDRICKSON.

Fief [from O. Fr. *fief*, *fien* (whence Eng. *fee*, estate), from O. H. G. *fihu*, cattle, property: O. Eng. *feoh*, cattle, property > Eng. *fee*, payment. See FEE]: an estate or dignity held of a feudal superior upon condition of military service. See FEUDAL SYSTEM.

Field: See DYNAMO-ELECTRIC MACHINES.

Field, CYRUS WEST: a son of the Rev. David D. Field, D. D. (1781–1867); b. at Stockbridge, Mass., Nov. 30, 1819; educated in Stockbridge; was a clerk in New York when fifteen years old, and a few years later became the head of a prosperous mercantile business. He traveled in 1853 in South America for six months, and on his return became interested in ocean telegraphy. Having been applied to for aid in building a land-telegraph across Newfoundland, to receive the news from a line of fast steamers to ply between St. John's and Ireland, he conceived the idea of carrying the wire across the Atlantic. In 1854 he obtained from the Legislature of Newfoundland the exclusive right for fifty years of landing telegraph cables from Europe and America on that island. Field next formed a company known as the New York, Newfoundland, and London Telegraph Company, with Peter Cooper, Moses Taylor, Marshall O. Roberts, and Chandler White, and in two years the lines were finished from New York across Newfoundland. The first cable to extend from Newfoundland to Cape Breton island having been lost in a storm while it was being laid in 1855, a second cable was laid in 1856. In that year he went to London and organized the Atlantic Telegraph Company, of which he furnished one-fourth of the capital. The U. S. and British Governments furnished ships for the enterprise. Field accompanied the expedition of 1857, the two of 1858, and those of 1865–66 for the laying of cables. Of these, the first two were failures, and the cable laid by the third worked but a short time. The public lost faith in the enterprise, civil war followed in the U. S., and Field could not obtain the capital to renew the attempt until 1865. In that year the Great Eastern laid 1,200 miles, when the cable parted, and was lost for the time. In 1866 a cable was successfully laid, and the cable of 1865 was picked up in mid-ocean by the Great Eastern and completed. Field was the recipient of many medals, of the thanks of Congress, and of other honors at home and abroad. He was subsequently engaged in other large enterprises, among which was the construction of elevated railroads in the city of New York. D. in New York city, July 12, 1892.

Field, DAVID DUDLEY, D. D.: clergyman; b. at East Guilford, now Madison, Conn., May 20, 1781; graduated at Yale College 1802; was settled at Haddam, Conn., from 1804 to 1818, and then at Stockbridge, Mass., from 1819 to 1837; then at same church as before in Haddam from 1837 until 1851, when he returned to Stockbridge to spend his last days, and where he died Apr. 15, 1867. Besides many published sermons, he was the author of a *Life of David Brainerd*, a *History of Middlesex County*, *Conn.*, and of *Berkshire County*, *Mass.*

Field, DAVID DUDLEY, LL. D.: jurist; b. at Haddam, Conn., Feb. 13, 1805; eldest son of Rev. David Dudley Field; entered Williams College in 1821. In 1825 he began the study of the law, and was admitted to the bar in 1828, and settled in New York, where he soon made his way to the front rank of his profession. Finding the practice of the law, which was after the English model, extremely complicated, dilatory, and expensive, he began to study how it could be revised and improved, and so entered upon those labors in favor of law reform which were to occupy so large a part of his life. In 1839 he published his first essay on the subject, which he continued to press upon the public attention until in 1847 he was appointed by the Legislature of New York one of a commission to reform the practice of that State. Upon this work he was engaged for two years, and the result was contained in two codes of procedure, the one civil and the other criminal. The code of civil procedure was in great part adopted by the State of New York, and has since been adopted by twenty-seven States and Territories. It is the basis of the legal reform established by the Judicature Acts in England, and of the practice in several of the British colonies, including India. After the completion of these codes he was in 1857 placed by the State of New York at the head of a new commission to undertake a codification of the whole body of the law. This was a work of years, but in 1865 the commission reported a civil code, a penal code, and a political code. These five codes, which were mainly the work of Mr. Field, covered the whole province of law in the U. S., both common and statute, and were designed to supersede the unwritten or common law—the object being to give the people in this compact form the whole of the laws by which they were governed. This body of law has been adopted in full and intact only by the State of California and the States of North and South Dakota. In 1867 he brought before the British Association for Social Science a proposition to frame an international code. This led to the preparation by him of what was really a complete work on international law, though modestly entitled *Outlines of an International Code*, one feature of which was the introduction of the principle of arbitration to settle disputes between nations. This work has attracted great attention in Europe, and been translated into French and Italian. The code of criminal procedure and the penal code have become a part of the law of New York, and the civil code has been twice passed by the Legislature, but has been defeated by the Governor. Mr. Field was one of the founders of an international association formed in 1873 for the purpose of reforming and codifying the laws of nations, the special object being the substitution of arbitration for war in the settlement of disputes between nations. He was a member of the peace conference at Washington in 1861, and of the House of Representatives of the U. S. in 1877. In 1890 he presided at the great peace convention in London. He published *The Electoral Votes of 1870* (New York, 1877), and *Speeches and Arguments before the Supreme Court of the United States, and Miscellaneous Papers* (New York, 1884). D. in New York, Apr. 13, 1894.

Field, Eugene: journalist and poet; b. in St. Louis, Mo., Sept. 2, 1850. He was educated at the University of Missouri; was connected with different newspapers in Missouri and Colorado from 1873 to 1883, when he joined the Chicago *Daily News*. Among his publications are *A Little Book of Western Verse* (1889); *A Little Book of Profitable Tales* (1889); *With Trumpet and Drum* (1892); *A Second Book of Verse* (1893). D. in Chicago, Ill., Nov. 4, 1895. H. A. B.

Field, Frederick, LL. D. (Cambridge. 1875): clergyman; b. in London, 1801; graduated at Trinity College, Cambridge, in 1823. He edited the Greek text of St. Chrysostom's *Homilies on St. Matthew* (3 vols., Cambridge, 1839); *Interpretation of the Pauline Epistles* (7 vols., 1849–62); and the Septuagint version of the Old Testament according to the *Alexandrian Codex*. In 1842 he was presented to the rectory of Reepham, Norfolk; resigned in 1863, and edited Origen's *Hexapla* (2 vols., 1867–74). He was one of the revisers of the Old Testament. D. at Norwich, Apr. 19, 1885.

Field, Henry Martyn, D. D.: author; a son of Rev. David D. Field, D. D.; b. at Stockbridge, Mass., Apr. 3, 1822; entered Williams College at the age of twelve; graduated at sixteen; studied theology three years at East Windsor, Conn., and one year at New Haven; at twenty took charge of a church in St. Louis, Mo., where he resided from 1842 to 1847, when he resigned, and spent the following year in Europe. In 1851 he was settled over a Congregational church in West Springfield, Mass., where he remained four years. In 1854 he removed to New York to become one of the editors of *The Evangelist*, of which he was sole proprietor until Feb., 1899. He is author of a number of volumes of travel, including *Summer Pictures: from Copenhagen to Venice* (1859); *From the Lakes of Killarney to the Golden Horn* (1876); *From Egypt to Japan* (1877); *Among the Holy Hills* (1884); *Old Spain and New Spain* (1888); and *Gibraltar* (1888). Travels at home furnished subjects for works entitled *Blood is Thicker than Water* (1886) and *Bright Skies and Dark Shadows* (1890). Other works include *The Irish Confederates and the Rebellion of 1798* (1851) and a *History of the Atlantic Telegraph* (1866).

Field, John: See the Appendix.

Field, Joseph M.: actor and dramatist; b. in London, England, in 1810; at an early age taken by his parents to the U. S.; was educated in New York city, and studied law; then became an actor, appearing first in 1843; settled in St. Louis, and, besides writing local plays, established the *Reveille*, a daily paper of which he was one of the editors. He published *The Drama in Pokerville and Other Stories, by Everpoint* (1847). Removed to Mobile, Ala., and died there Jan. 30, 1856.

Field, Kate: journalist; daughter of Joseph M. Field; b. in St. Louis, Mo., about 1840; educated in Massachusetts and in Europe; she was European correspondent of the New York *Tribune* and other journals; wrote for *The Atlantic Monthly* and other magazines; gave lectures and public readings, and in 1874 made her appearance as an actress in the character of Peg Woffington at Booth's theater, New York. In 1889 she established at Washington, D. C., *Kate Field's Washington*, a weekly journal. D. in Honolulu, May 19, 1896. Among her books are *Planchette's Diary* (1868) and *Ten Days in Spain* (1875). H. A. B.

Field, Richard Stockton, LL. D.: judge; b. at Whitehill, N. J., Dec. 31, 1803; graduated at the College of New Jersey in 1821; was professor in the New Jersey Law School 1847–55; for a long time attorney-general of New Jersey; U. S. Senator in 1862–63, in place of J. R. Thompson, deceased, and the judge of the district court of the U. S. for New Jersey until his death at Princeton, N. J., May 25, 1870. Published *The Provincial Courts of New Jersey* (1849), and contributed to the collections of the New Jersey Historical Society.

Field, Stephen Johnson: judge; son of Rev. David D. Field; b. at Haddam, Conn., Nov. 4, 1816; graduated at Williams College in 1837; studied law with his brother, David Dudley Field, in New York, and on his admission to the bar became his partner; went to California in 1849; in Jan., 1850, was elected first alcalde of Marysville, and in October was elected to the Legislature, and served one session; in 1857 was elected judge of the Supreme Court of the State, and in 1859 became chief justice; from 1863 to Dec. 1, 1897, was an associate justice of the Supreme Court of the U. S. In 1869 Judge Field was appointed Professor of Law in the University of California. In 1873 he was appointed by the Governor of California one of a commission to examine the codes of the State, and to prepare amendments to the same for the consideration of the Legislature. In 1877 he was a member of the Presidential Electoral Commission (*q. v.*), and voted with the seven in favor of Mr. Tilden against the eight in favor of Mr. Hayes. In 1880 he received 65 votes on the first ballot in the national Democratic convention as a candidate for President of the U. S. D. in Washington, D. C., Apr. 9, 1899.

Fieldfare: the English name for a species of thrush, *Turdus pilaris*, found in Europe, and commonly occurring in England as a bird of passage, although it sometimes breeds in the northern portions of Great Britain and Scotland. The fieldfare is variegated in color, but the general hue of the upper parts is chestnut brown; the head is gray, the quill feathers and tail blackish; the throat is reddish yellow streaked with black, the breast brown; the rest of the under parts white. F. A. Lucas.

Field-glass: a form of magnifying apparatus which is essentially a telescope of low power. It may have a single tube (like the antiquated spy-glass), or more frequently it is binocular, resembling in form the double opera-glass. See Telescope.

Fielding, Anthony Vandyke Copley: landscape-painter in water-colors; b. in England, 1787. He was a member of the British Society of Water-color Painters, and a clever and rapid workman. A large collection of his drawings is in the South Kensington Museum. D. at Worthing, England, 1855. W. A. C.

Fielding, Henry: dramatist and novelist; b. at Sharpham Park, near Glastonbury, Somersetshire, England, Apr. 22, 1707. He began his education at home under the care of Mr. Oliver, the family chaplain, said to have been the original of Parson Trulliber in *Joseph Andrews*. He studied at Eton, but, being destined by his father for the law, he was, at the age of eighteen, transferred to the University of Leyden. He was a diligent student for about two years, when, owing to the inability of his father to pay his expenses, he was compelled to return to London, where, at the age of twenty, he found himself dependent upon his own resources. His first effort, a comedy entitled *Love in Several Masques*, appeared in Feb., 1728, and was favorably received. Between his first appearance as a dramatic author and 1737, Fielding wrote twenty-three pieces for the stage, most of them comedies and farces. Of these only one proved decidedly successful—a burlesque entitled *The Tragedy of Tragedies, or the Life and Death of Tom Thumb the Great*, intended to ridicule the extravagant style of the tragedies of the day. *The Mock Doctor* and *The Miser*, translations of Molière's comedies, were also well received. In 1735 he married Miss Cradock, one of the belles of Salisbury, and possessed of a small fortune of £1,500. Fielding had succeeded, on his mother's death, to a small estate at East Stour in Dorsetshire, to which he now retired and assumed the character of a country squire of the first magnitude, by which his slender means were rapidly dissipated, and in a very short time he was compelled to break up and return to London and seek means for the support of his wife and child. Intending to apply himself to his profession, he was turned aside by an opportunity of producing a satirical drama—*Pasquin, a Dramatic Satire on the Times*; its success was so great that in 1737 he produced another, *The Historical Register for 1736*, which attracted so much attention that the Licensing Act, placing the stage under ministerial control, was passed. Resolving now to devote himself to the law, he entered himself (Nov. 1, 1737) as a student of the Middle Temple. In 1740 he was called to the bar, took chambers, and commenced practice. To the columns of *The Champion*, in which he was interested, he contributed largely. He also compiled a valuable work on crown law. Circumstances now led Fielding to turn his attention to the sphere in which he was destined to win enduring renown. In Feb., 1742, his first novel—suggested by Richardson's *Pamela*, which had appeared in 1740 and had created an extraordinary sensation—was published under the title of *The Adventures of Joseph Andrews and his friend Abraham Adams*. Its success was immediate; it soon became a universal favorite, and was regarded as the best work of fiction produced up to that time in the English language. *The Wedding Day*, a comedy written several years before, was produced in Feb., 1743. The *Miscellanies* appeared in 1743; *A Journey from this World to the Next*, in the second volume, is an admirably contrived satire, though in a fragmentary state: the third volume is entirely taken up with *The History of Jonathan Wild the Great*, the least agreeable of Fielding's works of fiction. In this year Fielding's affectionate wife died—a calamity that so deeply affected him that for a time his reason was endangered. As soon as he was sufficiently recovered he again applied himself to his profession. During the memorable events of 1745 he published a political journal, *The True Patriot*, which expired with the suppression of the rebellion. In 1747 he started another political paper, called *The Jacobite Journal*, which was discontinued toward the end of 1748, when he received the appointment of justice of the peace for Middlesex and Westminster—a sphere of duty in which he speedily earned for himself credit and distinction. The office was not at this time held in high estimation by reason of the trafficking in committals and convictions for the fees which formed the compensation of the magistrates, and for which practice they were termed "trading justices." Fielding refused to adopt these discreditable practices, and labored ardently to check the growth of depravity and crime; and his services in this department of life alone were of such importance as to entitle him to the respect of posterity. In 1749 he published his great work, upon which he had been long engaged, *The History of Tom Jones, a Foundling*, which placed him at the head of English novelists. Its success was decided, and it still maintains a prominent place among works of fiction. In 1749 Fielding was elected chairman of the sessions, which entailed upon him the additional duty of attending at the bench. In addition to these duties he published several valuable tracts, among which *An Inquiry into the Increase of Thieves and Robbers* attracted much attention. In 1751 he produced another work of fiction, *Amelia*, in which work the heroine is intended as a portrait of his first wife. This was Fielding's last production in fiction. In 1752 he published a literary journal called *The Covent Garden Journal*, and the following year several law reports. But the complication of disorders from which he had long suffered was fast undermining his strength, and a vigorous warfare which he successfully waged against the gangs of desperate ruffians then infesting London so wore upon his shattered frame that he was compelled to retire from the active performance of his duties. A trip to Bath was made without beneficial effect, and by the advice of his physicians he embarked for Lisbon on June 26, 1754. After a stormy voyage, of which he left an account, published in 1755 under the title of *The Journal of a Voyage to Lisbon*, he reached Lisbon in August. But his strength was too far declined to rally, and on Oct. 8 he expired. See Murphy's *Life and Genius of Fielding*; Sir Walter Scott's prefatory memoir in Ballantyne's Novelists' Library; *Life of Henry Fielding*, by Frederick Lawrence, 1855; and Austin Dobson in the Men of Letters series (1883; new ed. 1889).

Field-marshal: See MARSHAL.

Field Mice: those mice which live out of doors and do not frequent houses; especially mice of the genus *Arvicola*, of which there are more than six species in the U. S., besides many species of allied genera and similar habits. Europe has also several species, and in Great Britain these mice are in some years extremely destructive, not only to grain-crops, but to orchard and forest trees, whose bark they gnaw. At times the British Government has paid bounties for their destruction.

Field Officer: in the army, a colonel, lieutenant-colonel, or major of a battalion or regiment, as distinguished from general officers, who are superior to field officers in rank; from line officers, who are inferior; and from staff officers, general or regimental, who may be of rank superior, equivalent, or inferior to that of field officers.

Field of the Cloth of Gold: the place on the border of the territory of Calais where occurred the famous interview between Henry VIII. of England and Francis I. of France, in June, 1520. Francis I. and Charles I. of Spain, candidates for the imperial crown, sought the friendship of Henry VIII. At this interview the magnificence of the display on both sides gave to the scene the name it bears. Henry VIII. had interviews with Charles the same year, and Francis's object was not secured.

Fields, JAMES THOMAS, LL. D.: author and publisher; b. at Portsmouth, N. H., Dec. 31, 1817. He was a member of the publishing firm of Ticknor, Reed & Fields, and its successor from 1838 to 1870. In 1849, 1854, and 1858, respectively, he printed volumes of his poems for private distribution. He edited *The Atlantic Monthly* at Boston from 1862 to 1870, repeatedly visited Europe, and had wide acquaintance with literary men abroad. He also lectured in the U. S., and published *Yesterdays with Authors*—reminiscences (1871); *Hawthorne* (1876); *In and Out of Doors with Charles Dickens* (1876). D. at Boston, Mass., Apr. 24, 1881.

Field-sports: See SPORTS.

Fieldworks: See FORTIFICATION.

Fi'eri Fa'cias [Lat., you shall or may cause it to be done]: a writ of execution (usually termed a *fi. fa.*), to secure the satisfaction of a judgment recovered against a debtor, directing the officer to whom it is addressed *to cause to be made* of the debtor's goods and chattels or real estate the amount therein specified. By this is meant that he is to levy upon the property and sell sufficient to obtain the requisite sum. Personal property is first sold, and afterward recourse may be had to the debtor's real estate. In executing this writ the sheriff has no authority to break open the outer door of a dwelling-house after request for permission to enter is refused, as may be done on criminal process; but if he has once secured lawful admission into the premises he may break through inner doors, open chests, etc., to secure possession of the goods. When the property is within the debtor's store or barn, even the outer door may be forcibly entered; so, if it be upon the premises of a stranger and entrance is refused, the house may be broken, for a man's house is a protection only for his own property. If, however, the goods are not found upon the stranger's premises, the sheriff is liable as a trespasser. For further details, see EXECUTION.

Fies'chi, fee-es'kee, or **Fies'co**, GIOVANNI LUIGI, de': Count of Lavagna; b. in 1523 at Genoa of a celebrated Guelfic family of remote Bavarian origin. A wealthy and ambitious demagogue, he entered into a conspiracy to kill Andrea Doria, doge of Genoa, and to overthrow the government, but the scheme failed in both its objects, and Fieschi, striving to seize the public galleys, was drowned Jan. 2, 1547.

Fieschi, GIUSEPPE MARIA: b. on the island of Corsica, Dec. 3, 1790; entered the French army in 1808; served in

Russia in 1812; was imprisoned 1816–26 for theft and forgery; went to Paris in 1830; invented the infernal machine by which the attempt was made, July 28, 1835, to assassinate Louis Philippe, who escaped with a slight wound, though sixteen of his attendants were killed or mortally wounded. Fieschi was executed Feb. 16, 1836.

Fiesole, Fra Angelico, da: a Florentine painter; b. at Vicchio, 1387. In early life he entered the Church in the order of Dominicans, and for the remainder of his existence may be said to have lived in a state of ecstasy, painting the visions which came to him. He was the last of the ecstatic school, and the last of the pure Giottesques. He had studied painting before he entered the order, but was appointed to the work he was so well fitted for as that in which he could best serve the Church. Fra Angelico stands as the type of the purely religious painter, not merely in his devotion to sacred subject, but in the devotional manner of approaching his subject as one in which an act of worship was accomplished and in which divine assistance was to be asked. His painting was to him the record of inspiration, and he never changed what he had done, which in part accounts for the limitations and for some of the loveliest qualities of what he did, the purity of color, the simplicity and harmony of his design, and for the immense quantity of work he left. The best of it is that at Rome in the chapel of S. Nicholas of the Vatican, the vault of the Duomo at Orvieto, and the frescoes at S. Mark's in Florence, but all the galleries of art in Europe have examples of it. His pupil Benozzo Gozzoli was the first in whom is found the evidence of unmistakable reference to nature for the facts of his representations. The last ten years of Fra Angelico's life were spent in great rapture in Rome, where he died in 1455. He was buried in the church of S. Maria sopra Minerva. W. J. Stillman.

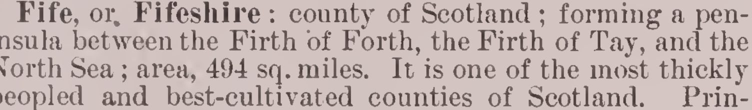
Fife [from Fr. *fifre*, from O. H. Germ. *pfîfa* > Germ. *Pfeife*, pipe, from Low Lat. *pi'pa*, deriv. of *pipa're*, chirp; cf. Eng. *pipe*, viâ Fr. from Low Lat. *pi'pa*]: a musical instrument chiefly used with the snare-drum in martial music. It is made in one piece, without keys, has six finger-holes, and a mouthpiece or hole for blowing upon one side, as in the flute. Its notes are shrill and somewhat harsh. The fife is variously pitched.

Fife, or **Fifeshire**: county of Scotland; forming a peninsula between the Firth of Forth, the Firth of Tay, and the North Sea; area, 494 sq. miles. It is one of the most thickly peopled and best-cultivated counties of Scotland. Principal towns, Cupar, Dunfermline, St. Andrews, Dysart, and Kirkcaldy. Pop. (1891) 187,320; (1901) 218,350.

Fife, Alexander William George Duff, Marquis of Macduff and Duke of: b. Nov. 10, 1849; educated at Eton; Liberal member of Parliament 1874–79; married July 27, 1889, Princess Louise Victoria Alexandra Dagmar, eldest daughter of the Prince of Wales, on which occasion he was created Duke of Fife.—The Duchess of Fife was born Feb. 20, 1867. She is president of the Edinburgh School of Medicine for Women, the first school of the kind in Scotland.

Fifteenth': in music, the interval of a double octave, comprising a distance of fifteen grades of the scale, from the lower to the upper note; also, the name of a stop in the organ, of which each pipe is tuned two octaves above the regular pitch as represented on the keyboard.

Fifth: in music, an interval comprising five degrees of the scale, or the distance, e. g., from C to G, D to A, etc. Fifths, according to their position on the scale or the influence of accidentals, are various in their compass, embracing from six to eight semitones. They are usually classified as *perfect*, *diminished*, and *augmented*. The perfect contains three whole tones and one semitone; the diminished, two whole tones and two semitones; and the augmented three whole tones and two semitones.



In counterpoint the progressions of the fifth are regulated by certain laws, partly arising from the harmonious nature and relations of this chord, and partly in view of the ease with which its use and abuse suggest themselves to the minds of young harmonists, who are unaware of the difficulties of its proper treatment. The restrictions, however, imposed by the old masters, have been so far relaxed in modern schools of music that certain progressions of fifths are now freely used which a century ago would have been strictly forbidden. Revised by Dudley Buck.

Fifth-monarchy Men: a small religious sect in England during Cromwell's protectorate and the first part of the reign of Charles II. They professed to believe that the time was near at hand when to the four great monarchies of Daniel's prophetic vision was to succeed the fifth, which was to break in pieces all others and to "stand forever." Of this Jesus was to be king, and in their eagerness to seize the fitting opportunity to proclaim him they conspired (Apr. 9, 1657) against Cromwell; and again (Jan. 6, 1661), on the prospect of Charles II. being fully restored to power, they rose in insurrection and attempted to sustain themselves, under a leader named Venner, by force of arms. The insurrection was promptly suppressed, and Venner and several others were executed. The Independents, Baptists, and Quakers formally disclaimed all sympathy with the insurgents, yet were made to suffer odium and civil hardships in consequence of the movement. Two years later another insignificant rising occurred, in consequence of which six persons are said to have been executed. The sect seems to have had no connection with Anabaptists on the Continent, but to have derived encouragement—however unwarrantably—from the views of some eminent men.

Fifth Nerve: See Facial Nerves and Trigeminus.

Fig [M. Eng. *fig*, from O. Fr. *figue* > Fr. *figue*: Ital. *fico* < Lat. *fi'cus*]: the fruit of *Ficus carica*, a deciduous tree of the *Artocarpeæ* or breadfruit family, 15 to 20 feet high, with rough and deeply lobed leaves, a native of Asia from Syria to the Caucasus and Kurdistan; also, the tree itself (see Ficus), which often lives to a great age. In the Scriptures the fig-tree is often mentioned, along with the vine, as a symbol of peace and plenty. Although unknown in Greece during the Homeric age, it was common in the time of Plato; it was early introduced into Italy, and thence in Spain and Gaul. Charlemagne ordered its cultivation in Central Europe, and it is now cultivated in most warm temperate climates. That it has succeeded even in England appears from the mention of the historian Matthew Paris that the year 1257 was so inclement that figs, cherries, and plums totally failed to ripen. Figs can be well ripened, and can be raised for preservation in the dried state, only where the summer and autumn are warm and dry. In the Eastern U. S. the main obstacle to their cultivation is the cold of winter, which frequently injures unprotected trees even in Florida. Figs are cultivated to some extent so far north as North Carolina, and the culture promises satisfactory results. On the Pacific coast they find a more congenial climate. The fig-tree bears two crops in a season—an earlier one from the axils of leaves of the preceding growth; a later and long-continued one from the axils of the leaves of the season. The fig is popularly said to fruit without flowering. This comes from the nature of this particular fruit—a hollow, pear-shaped receptacle, nearly closed or barely pervious at the broad apex, lined throughout the interior with innumerable small flowers, male and female. The so-called seeds are the ripened achenia (i. e. seed-like fruits) of the latter; the luscious pulp mainly belongs to the ripened and softened receptacle or hollow flower-stalk. A good idea of the botanical nature of a fig is got by comparing it with *Dorstenia*, of the same natural family; in this the flowers occupy the upper surface of a plate or saucer-shaped common receptacle. By imagining this saucer to deepen into a cup, and the cup to pass into the form of a jug by a contraction of the summit, the whole peculiarity of the fig-fruit will be apparent. In ripening, the acrid milky sap characteristic of the family is replaced by saccharine matter, chiefly grape-sugar, which serves to preserve them. Fresh figs, most agreeable to many, are too sweet and cloying for other palates, being destitute of acidulous flavor. In the fresh state, and still more in the dried, figs form an important article of food in the Levant, etc. Smyrna is the principal mart whence dried figs are exported to Northern Europe and America. Dried figs are said by the dealers to be *natural* when not compressed in the packing, but retaining their original shape, or *pulled* when after drying they are made supple by kneading, and then packed by pressure into drums or boxes. *Eleme* figs are merely those of superior quality, so called from a Turkish word meaning "hand-picked."

Figeac, fēe'zhaak': town of France; department of Lot; on the Sellé; 32 miles E. N. E. of Cahors (see map of Italy, ref. 8–E). It is a quaint old city, situated in a deep valley surrounded by rocky, vine-clad heights. It contains two Gothic churches, and has a trade in cattle and manufactures of cotton. Pop. (1896) 6,310.

Fighting-fish: a little fresh-water fish (*Ctenops pugnax*) of farther India, akin to the perch family. Two of these fishes placed in a vessel of water will attack each other with the utmost fury, and in India much money is often wagered upon the result of the combat.

Figig: See the Appendix.

Figueira da Foz, fēē-gā-ee'rāā-daa-fōs': seaport of Portugal; province of Beira, at the mouth of the Mondego; 23 miles W. by S. of Coimbra (see map of Spain, ref. 15–A). It has a lively trade in salt, oil, wine, and fruit, and is a favorite watering-place. Pop. 4,300.

Figueras, fēē-gā'rāās: frontier-town of Spain; province of Gerona; 25 miles by rail N. of Gerona (see map of Spain, ref. 13–L). On a height near the town is the citadel of San Fernando, one of the strongest fortresses of Spain and the key of the Pyrenees. There are manufactures of soap, paper, and leather. Pop. (1887) 11,912.

Figueras, Estanislao: statesman; b. in Barcelona, Spain, Nov. 13, 1819; received an excellent education; became at an early age one of the leaders of the liberal party in Catalonia; was elected to the Cortes in 1850; was a member of the revolutionary committee of Tarragona 1854; engaged in the liberal conspiracy of 1866, for which he was imprisoned in 1867, and took a prominent part in the organization of the republican party after the overthrow of Queen Isabella in 1868. On the abdication of King Amadeo (Feb. 11, 1873) he became provisional president of the republic, holding that post for about four months, when he retired from public life. D. at Madrid, Nov. 11, 1882.

Figueroa, fēē-gā-ro'āā, Francisco, de: a Spanish general and poet, often surnamed *El divino*; b. at Alcalá de Henares in 1540. During his long stay in Italy he acquired such a mastery of the Italian language that his Italian verse is as pure as that composed in Spanish. His poems, dating from the year 1572, but not published until 1620, rank among the best contemporary productions in Italian style. In his eclogue *Tirsis* he made successful use of the Italian blank verse, introduced into Spanish poetry by Boscan. D. at Alcalá de Henares in 1620. H. R. Lang.

Figueroa, Pedro Pablo: author; b. at Copiapó, Chili, Dec. 25, 1857. He was educated in his native place; was connected with various journals, and in 1885 established *El Imparcial*, a newspaper at Santiago. He has written numerous biographical works, sketches, and romances, among the best known being *Galería de Escritores Chilenos*; *Diccionario Biográfico Chileno*; *La Odisea del Desierto*; *La Cortesana* and *El Leñador* (novels.) H. H. S.

Figuier, fee'gee-ā', Guillaume Louis: chemist and scientific writer; b. at Montpellier, France, Feb. 15, 1819; became M. D. 1841; professor in the School of Pharmacy at Montpellier 1846; then scientific editor of *La Presse* at Paris. He published *Exposition et Histoire des Principales Découvertes Scientifiques Modernes* (3 vols., 1851–53; 5th ed. 1858); *Histoire du Merveilleux dans les Temps Modernes* (4 vols., 1859–60); *Vie des Savants Illustres depuis l'Antiquité jusqu'au XIXe Siècle* (1866); *Les Nouvelles Conquêtes de la Science* (1883–85); *Les Mystères de la Science* (1887), etc. D. in Paris, Nov. 9, 1894.

Figurate Numbers: those numbers which may be formed in the manner shown in the following table. The first column consists of the figure 1 simply; the second column is formed by adding one successively to each number, starting from the number 1. In the third column we also start from the number 1, and form each consecutive number by adding the next following number of the preceding column. All the following columns are formed in the same general way, starting with 1, and adding in succession the numbers of the column next preceding. This table is called

THE ARITHMETICAL TRIANGLE.

0th *order*....	1	1	1	1	1	1	1	1	.	.
1st *order*....	1	2	3	4	5	6	7	.	.	
2d *order*....	1	3	6	10	15	21	.	.		
3d *order*....	1	4	10	20	35	.	.			
4th *order*....	1	5	15	35	.	.				
5th *order*....	1	6	21	.	.					
6th *order*....	1	7	.	.						
7th *order*....	1	.	.							
. . . .										

This table may be continued to any desirable extent. The numbers in the first line are simple units; those in the second line are the natural numbers; those in the third line are called *triangular* numbers, because they express the numbers of balls that may be arranged in equilateral triangles as in the diagram:

o
o o o
o o o o o o
o, o o, o o o, o o o o, etc.;

those in the fourth line are called *pyramidal* numbers, because they express the numbers of balls that can be piled in the form of regular triangular pyramids; those in the fifth, sixth, and seventh lines have been called *trianguli-triangular*, *trianguli-pyramidal*, and *pyramidi-pyramidal* numbers. Hence the name *figurate numbers*.

It will be seen that the numbers of the table, read diagonally upward, are the numerical coefficients of the development of $x + a$ to a power whose exponent corresponds to the order of the series. This property, besides rendering the table useful in the formation of powers, enables one to use it, in the calculus of probabilities, to find the number of combinations of m things taken in sets of n. Thus to find the number of combinations of 7 things taken in sets of 1, 2, 3, etc., enter the table opposite the 7th order and read diagonally upward; the number in the second column is the number of combinations of 7 things in sets of 1; that in the third column is the number of combinations in sets of 2; that in the fourth column is the number of combinations in sets of 3; and so on.

It is this last property that connects the arithmetical triangle so closely with the logical *Abecedarium*. See Jevons, *Principles of Science* (London, 2d ed. 1877).

Revised by S. Newcomb.

Figured Bass: in music, a bass over or under which the harmony is expressed by ordinary figures, dashes, etc., instead of being written out in notes. These figures are not intended to represent the structure or *melodious movement* of the upper parts, but only the nature and elements of the *harmony* on which those parts depend. Nor do the figures usually determine the exact *positions* of chords as played by the right hand on keyed instruments; as such positions may be taken near the bass, or distant from it, or be in either close or dispersed harmony, at the discretion of the performer. The figures represent intervals counted *upward* from the bass; and generally those intervals which *exceed* an octave are expressed by figures denoting the same letter *within* the octave. Accidental flats, sharps, and naturals are used with the figures when necessary, but a sharp is frequently expressed by a stroke drawn through the figure. Figures standing one *over* the other indicate intervals to be struck simultaneously, but those standing one *after* the other are to be taken successively. The triad (or common chord), in its fundamental form, requires no figures, unless when succeeding a different chord on the same bass, or when there may be some ambiguity or obscurity in the progression. In keys having sharps or flats at the signature (at the beginning), those sharps or flats will of course affect the figures as well as the notes.

Dotted notes may be represented by dotted figures. Rests also may be introduced, though a small cipher (0) is preferable.

The words *tasto solo* imply that the bass is unaccompanied by harmony until the recurrence of figures.

For fuller information on the subject of figured bass, the student may consult J. G. Albrechtsberger's *General-bass-Schule*, Cherubini's *Treatise on Counterpoint*, and Beethoven's *Studien im Generalbass*.

Revised by Dudley Buck.

Figure of Speech: a peculiar or special use of words. The distinction between grammatical and rhetorical figures is of great importance in the logical construction of figurative language—a subject on which there is an extraordinary amount of confused thinking. The grammatical figure rests upon a *real* relation of the subject and predicate. "My Milton is in four volumes" involves a figure or form of speech departing from strict literalness; but it is a grammatical figure, for the relation on which it rests is real, objective, and undeniable: it is, according to the letter, the grammar, and hence has been styled the grammatical. Milton is literally the author of the works contained in the volumes. The two great grammatical figures are Metonymy (*q. v.*) and Synecdoche (*q. v.*). They may be at home in the plainest and most common-place prose—in the language of a will or of an advertisement. The rhetorical figure rests upon an ideal or an idealized relation between the subject and predicate. The mind makes it, and can unmake it; it can exist to one mind, and be denied by another; it may be conceded by the mind at one time and in one state, and denied at another time. "Milton is an eagle" involves a METAPHOR (*q. v.*), which is the chief rhetorical figure. Some of the most confused and persistent logomachies have arisen from failing to observe this distinction.

Figures: visible signs used to represent numbers. See NUMERALS.

Figworts: a family of flowering plants (*Scrophulariaceæ*) with two-lipped or irregular gamopetalous corollas, superior two-celled ovaries, and two or four (rarely five) stamens on the corolla-tube. They are mostly herbaceous plants, although some are trees. There are about 2,000 species, widely distributed throughout the world. Many species are cultivated for their fine flowers, e. g. snapdragon (*Antirrhinum*), *Mimulus*, *Pentstemon*, *Digitalis*, *Calceolaria*, etc. The Paulownia-tree (*Paulownia imperialis*) of Japan is planted in the Southern U. S. CHARLES E. BESSEY.

Fiji, fee'jēe, or **Viti Islands** (formerly written *Feejee*): a group of islands constituting a British dependency; in the South Pacific Ocean; between lat. 15° 30′ and 20° 30′ S., and lon. 177° E. and 178° W.; numbering over 200 islands, of which about 80 are inhabited; gross area, 7,451 sq. miles. They were discovered in 1643 by the Dutch navigator Tasman, but not fully explored until 1840, when they were visited by the American navigator Wilkes. The two largest islands are Viti Levu, having an area of 4,112 sq. miles, and Vanua Levu, of 2,432 sq. miles; the others are small. The Fiji islands are of volcanic origin; earthquakes are common and hurricanes periodical. The soil, which consists of a deep-yellow loam, and is well watered, is exceedingly fertile, and the moist and hot climate (the temperature ranging from 60° to 120°), calls forth a most luxuriant vegetation, consisting of bread-fruit trees, bananas, cocoanuts, sugarcanes, and tea-plants; cotton grows wild. The inhabitants are middle-sized, strong-limbed, short-necked, with a complexion between copper-color and black. Before the introduction of Christianity by Wesleyan missionaries in 1835 they were a fierce race of cannibals. The majority have become Christianized, about 100,000 being adherents of the Wesleyans and more than 10,000 of the Roman Catholics. In 1861 the king and chiefs of Viti Levu formally offered the island to Great Britain; but it was not until 1874 that the British flag was hoisted on Fiji soil. The population of these islands has greatly decreased since about 1845. Pop. (1895) 120,245, of whom 101,316 were Fijis and 2,872 Europeans, 9,861 Indian immigrants, the remainder being other Polynesians, half-breeds, Chinese, etc. Suva, in Viti Levu, is the capital. See FIJI ISLANDS in the Appendix.

Filament [from Fr. *filament* < Late Lat. *filamen'tum*, deriv. of Late Lat. *fila're*, spin, deriv. of Lat. *fi'lum*, thread. Or *filamen'tum* and *fila're* may both be derived by analogy from Romance derivatives]: in the descriptive botany of flowering plants, the support or stalk of the anther of the stamen; "it is to the anther what the petiole is to the blade of the leaf" (*Gray*). Elsewhere in botany the term has its usual meaning of a thread; thus the filament of a mould is a thread composed of a cell or a row of cells. See FLOWER.

Filangieri, fēe-lăăn-jēe-ā'rēe, GAËTANO: author; b. at Naples, Italy, Aug. 18, 1752; entered the army 1766; went to the royal court 1777; became a member of the supreme council of the finances 1787. He is chiefly remembered as author of *Scienza della legislazione* (1780–88, unfinished), a noble treatise on the principles of legislation. D. at Vico-Equense, July 21, 1788.—His son CARLO (1783–1867), Duke of Taormina, was a brave soldier under Napoleon, governor of Sicily under Ferdinand II., and Prime Minister under Francis II. of the Two Sicilies.

Filaria: See HÆMATOZOA and PARASITES (Human).

Filbert [formerly also *filbeard* < M. Eng. *filberde*, perhaps named from St. *Philibert*, the forms with *-d* arising from analogy with *beard*. Cf. the Germ. name *Bartnuss*, liter., beardnut]: the nut of the HAZEL (*q. v.*). The name is not often applied to the American wild hazel-nuts; and in commerce the round varieties of European hazel-nuts are called cob-nuts, the name *filbert* strictly belonging to the elongated sorts, which have also a finer-cut and more beard-like envelope; whence perhaps the name. Filberts are chiefly the product of *Corylus avellana*, the common hazel of Europe and Asia, which is extensively cultivated. Barcelona nuts are a variety of filbert, kiln-dried for better keeping. *Corylus colurna*, of Turkey, produces large, oily filberts. Filberts are used as dessert-nuts. Large amounts of oil (nut-oil) are also expressed from the kernels; it is a drying oil, much used by artists and makers of choice varnishes. But few filberts are grown in the U. S. Several species are known.

Fildes, SAMUEL LUKE: genre and portrait painter; b. at Liverpool, England, Oct. 14, 1844. Pupil of South Kensington Art School and Royal Academy, London; Royal Academician; second-class medal, Paris Exposition, 1889. He began his artistic career as an illustrator for the London *Graphic*, *Cornhill Magazine*, etc. *Applicants for Admission to a Casual Ward* (1874) is one of his most celebrated pictures. His work is technically of fair merit, but he inclines to story-telling in his pictures at the sacrifice of truth to nature. His portraits of women are graceful, but somewhat lacking in expression of character. Studio in London. WILLIAM A. COFFIN.

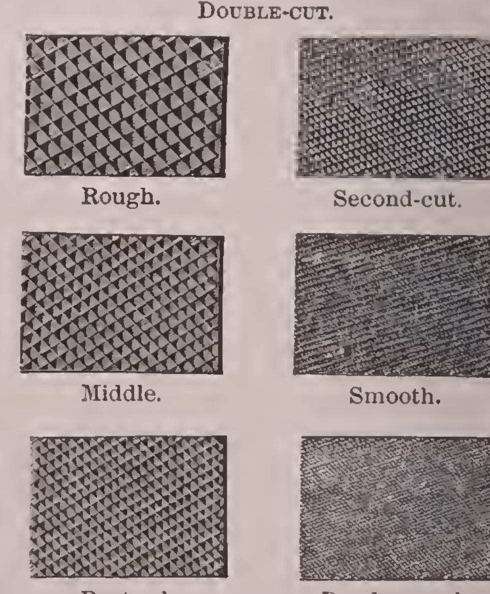
File [M. Eng. *file* < O. Eng. *fēol*: O. H. Germ. *fīhala* > Mod. Germ. *Feile*]: a tool used in shaping all kinds of materials of construction. It is a bar of steel, the size and shape of which are determined by the use for which it is intended. Its surfaces are covered with sharp cutting edges or teeth, the direction and number of the edges and the magnitude and distribution of the teeth varying with the nature of the material to be cut and the degree of smoothness of the surface which the file is required to produce. Where the surface has isolated sharp teeth separated by comparatively wide spaces the file is called a *rasp*.

Files are used upon surfaces of all kinds. Rasps are especially fitted for rapid work on surfaces of materials having slight resisting power. They are used by workers in wood and leather, and by the farrier. The effect of rubbing the file upon the surface of the metal, wood, ivory, or other material to be changed in form or dimensions, is to abrade it, cutting from it minute shavings or small particles, and reducing the mass by a gradual process. Files are therefore used only in shaping small pieces or in "finishing" surfaces which are already of approximately correct figure. The file usually follows the work of the lathe or the planer-tool.

The forms given to files, as well as their shapes and sizes, are almost numberless. Those files which have cutting edges extending unbroken from side to side are called "floats" or "single-cut" files. Those which have two sets of such edges, crossing each other at an angle, are called "double-cut." The effect of such crossing of edges is to produce points or teeth, rather than true cutting edges.

The coarseness or fineness of the file is known by the trade-terms: 1, rough; 2, middle-cut; 3, bastard; 4, second-cut; 5, smooth; 6, superfine or dead-smooth. The second grade is rarely found in the market. The most common are the "Sheffield cuts," rough, bastard, and smooth. These are shown in the accompanying sketches. In what are known as the Nicholson or "increment - cut" files the forms of the teeth and the cutting edges are very similar to those of ordinary files as just described. These are machine - cut files, but they differ from other machine-cut files by being cut with teeth slightly expanding or increasing in size and space from point to heel, thus avoiding the great regularity of teeth common to ordinary machine-cut files. The irregularity spoken of consists not only in the spaces between the teeth, but also in the heights of the teeth themselves.

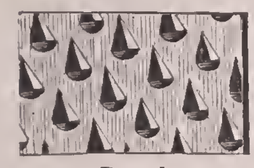
DOUBLE-CUT.



Rough. Second-cut. Middle. Smooth. Bastard. Dead-smooth.

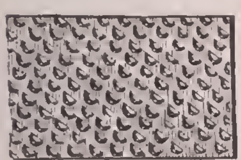
The regularity of the teeth, so characteristic of most machine-work, is not easily obtained by the hand-worker, who, seated with his blank firmly held on a stone block in front of him, strikes the chisel into the blank and raises the first tooth; the chisel is then lifted out of its groove, placed on the blank, and slid up until it comes into contact with the tooth previously raised, when the second blow is struck and another tooth is produced. If the force of these blows were alike in each case, the spaces would be equal; but as it is impossible for the most expert workman to strike the great number of blows required in the entire side of a file with exact uniformity, irregularity in the distribution of the teeth must exist.

RASP-CUT.



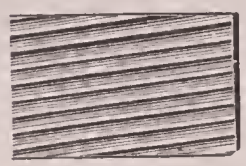
Rough.

Bastard.

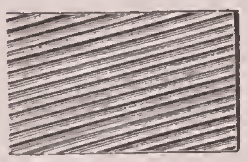


Smooth.

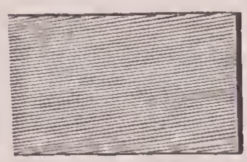
FLOAT-CUT.



Rough.



Bastard.



Smooth.

Possibly, the failure of many of the earlier enterprises may be traced in a measure to the defect in their machinery of producing this extreme regularity in the cut of their files. When a side or an edge of a file is left uncut, it is said to be "safe."

Watchmakers' files are often exceedingly delicate, measuring less than an inch in length, and having a thickness not greatly exceeding that of a coarse bristle. The larger files used by watchmakers seldom exceed 4 inches in length. Mechanics working on tools, small apparatus, and light machinery, use files of from 6 to 12 inches in length, and machinists employed on steam-engines and heavy machinery call for files of from 10 to 18 inches in length, and occasionally, for special purposes, use files of double these sizes. The shape of the cross-section of the file is usually either that of a square, a parallelogram, a circle, an oval, a triangle, or a combination of straight lines and arcs of circles. Fig. 1 represents the parallel hand file, called, when small, a pottance file, or if very slender a pillar file. This file is also called a verge or a pivot file, and when of large size a cotter file. Fig. 2 represents the square file, which is often, as is the case with all other forms of section, made with parallel sides. Fig. 3 represents the knife file. This form is usually small, and is of limited use. It is made for the purpose of cutting or enlarging narrow, triangular notches. Fig. 4 exhibits the half-round file, the section of which, as seen, is not a complete semicircle. The thickness of the file is usually from one-half to one-fourth the radius of the circle. Fig. 5 represents the round file. If of small size it is called, when tapering, a rat-tail file, and when parallel a joint file or gulleting saw file. Fig. 6 represents the triangular file, often called by the workman a three-square file. It is used for sharpening saws, for cutting internal angles, and for cleaning up corners. Fig. 7 resembles Fig. 1, but the file is thinner. It is known as a warding file, and was formerly much used by locksmiths in cutting the wards of the keys of locks. Fig. 8 is the cross or double half-round file, the two sides usually having different curvatures. The first name is derived from the fact that it was originally designed for trimming out the crosses or arms of small wheels. Fig. 9 is the slitting, feather-edge, or screw-head file, having two knife edges, and used for the same purpose as the knife file.

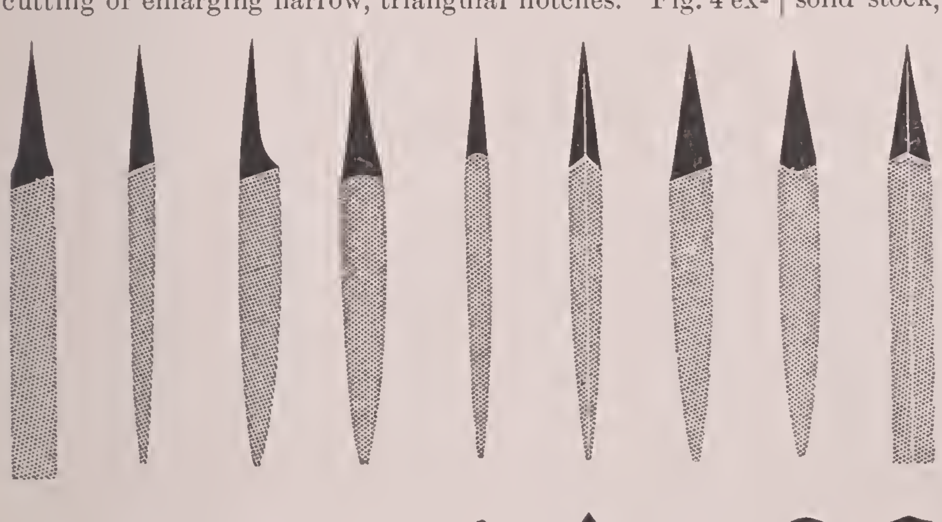


FIG. 1. FIG. 2. FIG. 3. FIG. 4. FIG. 5. FIG. 6. FIG. 7. FIG. 8. FIG. 9.

FIG. 10.

Equaling files are flat and thin. They are always uniform in thickness, and usually in width also. Two opposite surfaces are frequently left "safe." "Rubbers" are large, heavy, coarse files, usually of inferior quality, which are used for rough kinds of work. "Rifflers" or bent files are of the shape shown in Fig. 10, and have usually curved surfaces. They are used by sculptors and by makers of ornamental castings. They are double-cut, single-cut, or rasp-cut, and of various degrees of fineness, as required for different kinds of work. They are especially adapted for smoothing up irregular forms, such as are most frequently met with in bronze castings.

The common kinds of file are frequently bent for convenience in working upon curved surfaces. Bending is readily accomplished by heating to a red heat and shaping over a properly formed wooden block by striking it light blows with a wooden mallet. When the file has thus been given the desired shape, it is re-tempered and is ready for use. The file is bent to a smaller radius than that of the concavity in which it is to be used.

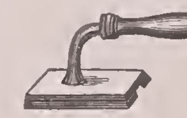


FIG. 11.

The tapering end of the file outside the shoulder, and upon which the handle is driven, is called the tang or the shank. The tapering form given the tang is not well adapted to give a firm hold to the handle, and it has probably been adopted and retained partly through conservatism and partly because workmen frequently use one handle for several files, and the tapering tang permits the file to be readily inserted into and withdrawn from the handle. To insure a good "hold," a tang of uniform section, and either cylindrical or prismatic in form, would be preferable. In the round screw-thread file the cutting edges are formed by making a ratchet-thread in the lathe, different pitches of thread thus making different grades of file. The cutting edges of these files are thus formed from the solid stock, and are said to possess remarkable endurance, and, acting like milling tools, do rapid and good work.

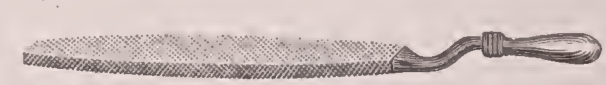


FIG. 12.

The handle of the file is usually driven directly upon the tang. It sometimes happens, however—as in filing extended flat surfaces, for example—that the file-handle interferes with the use of the file by bearing upon the surface and preventing the cutting portion of the file coming down to its work. In such cases the tang is bent or a "holder" is used, as in Figs. 11 and 12.

Files are usually made of the best of material, and great care is taken to select steel that is uniformly and highly converted. "Rubbers" for smiths' use are made from blistered steel, but all other files are made from better grades of steel. Files are forged into shape in a similar manner to all small work in steel, the smith taking care not to work the metal at a higher than a blood-red heat. Peculiar shapes are produced in dies or formers. Special care is taken to select good fuel for the fires in which the blanks are forged. It is usually coke, made from coals free from any trace of sulphur. The blanks are very thoroughly annealed after having been forged. The finer qualities are annealed or "lighted" in iron boxes, in which they are embedded in sand. Cheaper grades are annealed in ordinary annealing ovens—a less expensive method, but one in which the blanks are less completely protected against the access of air. The annealed blanks are next ground into the exact shape demanded, and the scale formed during the antecedent process is removed, leaving a clean and properly formed surface for the file-cutter to work upon. It was formerly customary to shape the blanks by filing, but the use of the grindstone is now much more usual. After grinding, the blanks are greased and sent to the file-cutter.

When *file-cutting* is performed by hand, the tools used consist of peculiarly shaped hammers and chisels, an anvil, and packing pieces of lead or pewter. The hammers weigh from 1 to 5 or 6 lb., the smaller sizes being used for very small and the heavier for very large files. They have a singular form, such as would be obtained by making the head first in the form of a truncated pyramid—the upper and lower bases having a breadth equal to about one-fifth and one-fourth its altitude respectively—and then bending it to an arc of a radius equal to about twice the altitude. The handle is inserted at a point considerably nearest the smaller end. In striking a blow the hammer is pulled toward the workman as it descends, the mass taking a direction approximating to that of the inclination of the chisel. The chisel is short and light, nearly a triangle in form, with a broad, straight edge. It is held between the finger and thumb of the left hand, much as a pen is held by the right hand in writing. The file-blank is placed upon the anvil, where it is held by a strap passing over each end and tightened by the workman, who places his feet in the "bight" of the strap as a horseman places his feet in his stirrups. As each blow is struck the workman moves the blank slightly to bring the chisel over the proper place for the next cut, the strap being loosened at the instant to allow the movement to take place.

In making small and smooth or dead-smooth files, the blows and these nearly simultaneous movements succeed each other with surprising rapidity. The smallest files are often cut by women or by boys and girls. The surface of the file being single cut, a second set of cuts is usually made at a large angle with the first, the two sets making angles of about + 50° and − 80° respectively with the middle line of the file. Before making the second cut the tops of the teeth already formed are smoothed off by lightly running over them a fine file. The blank is then turned over, and the opposite side and the edges are next cut. When a surface already cut is placed downward, a strip of lead or pewter is placed beneath it, to prevent injury of the teeth by contact with the hard surface of the anvil. By constant practice the workman becomes very expert, and the rapidity and accuracy of his work are quite wonderful, and are probably among the finest illustrations of the degree of perfection in workmanship which may be attained by the hand when guided by a delicate sense of touch.

After cutting, the files are next hardened, although those made for use on wood and other comparatively soft substances are frequently left unhardened, and several kinds which are made of peculiar shapes for some purposes, as for sculptors, are made of good iron and case-hardened. The files to be hardened are first besmeared with a mixture of salt and carbonaceous materials which are considered to be best adapted to preserve the teeth from decarbonization and oxidation, and which at the same time, by fusion upon the surface, may indicate the proper heat at which to temper. This surface-coating of comparatively non-conducting material also checks the first sudden change of temperature on immersion in the tempering liquid, and thus decreases the liability of the file to crack. The difficulty which might be experienced from the change of shape which invariably occurs to a greater or less extent on suddenly cooling the file is avoided by giving the untempered file a slight distortion in the opposite direction, so that the subsequent change of shape may leave it in the desired form. In all cases the general shape of the file is determined previous to the operation of hardening.

When the file has been heated in the fire to a temperature at which the surface-coating fuses, it is taken by the tang and suddenly immersed in a tank of water, the rapidity and particular direction of the immersion being determined by the size and shape of the file. Withdrawing it before it becomes cold, the workman inserts it between the jaws of a clamp or between a pair of iron bars, where he corrects by force any slight defect in form, while pouring water over it to cool it thoroughly. The tang is next softened by immersion in molten lead; the file is then scrubbed thoroughly and washed in lime-water to remove the scales of salt mixture. It is carefully dried and oiled, and is then ready for the market.

A careful system of inspection is adopted by the best makers, by which all imperfect files are detected and thrown out to be sold as "wasters." Those files which pass inspection are packed by dozens in papers.

The time at which files were first made is unknown. The manufacture of files was introduced into North America very soon after its settlement. File-cutters settled in Pennsylvania at the end of the seventeenth century. The firm of Broadmeadow & Co. began file-making in Pittsburg in 1820, and there are now a considerable number of file-manufacturers in the U. S.

File-cutting machinery was probably first proposed nearly two centuries ago. A Parisian mechanic, Duverger, presented a file-cutting machine to the Académie des Sciences in the year 1699, and a description of this apparatus appeared in the *Journal des Savants* in 1702. Thiout in his *Traité de l'Horologie*, published at Paris in 1740, describes another machine. Still later, Raoul, another French mechanic, made files by machinery, and obtained a report upon them from a committee of the Lycée des Arts in which it was stated that they were equal to the best English hand-made files. In 1812 Morris B. Belknap, of Greenfield, Mass., patented a file-cutting machine, and William T. James, who is said to have worked at Union Village, patented another. In 1836 Capt. John Ericsson, then in England, patented a file-cutting machine, which is described in Holzapffel's work on *Mechanical Manipulation*, where it is stated that one machine could do the work of ten men. In 1847 an ingenious machine was invented by George Winslow, of Boston, and was described in Appletons' *Dictionary of Mechanics.* Still later, a machine was invented by M. Bernot, of Paris, and was described in detail by Byrne. This machine was used to some extent with success in France and Belgium, and subsequent to 1860 was introduced into Great Britain and the U. S. In this machine the chisel is driven by a cam as the file-blank moves along beneath it, and the difference in height of teeth which is given by the hand-process in passing from the end to the middle of the file, and the reverse, is thus imitated. Considerable sums of money were expended in the effort to make this process a success in Birmingham, but in vain. File making by machinery is an important industry in the U. S., some of the plants having facilities for producing from 30,000 to 40,000 per day each, and for supplying over 3,000 varieties. This is done so cheaply that it no longer pays to recut worn files, a process in common use when all files were made by hand.

R. H. THURSTON.

Filefish: a fish of the family *Balistidæ* and the order *Plectognathi*. The filefishes have a conical muzzle, terminating in a mouth furnished with teeth in both jaws. In *Balistes* proper (see BALISTIDÆ) there are eight teeth in a single row in each jaw; their bodies are covered with hard rhomboidal scales, having the appearance of the teeth of a file; and they are furnished with spines in relation with the dorsal and other fins. The filefishes are brilliantly colored and abound in warm seas: several species occur on the Atlantic coasts of the U. S. The species represent several very distinct types of structure, varying in the development of the spinous dorsal fin, the position of that fin (which in some species is very far forward), the character of the scales, etc.

Revised by F. A. LUCAS.

Filelfo: See PHILELPHO.

Filibuster [from Span. *filibustero*, *flibustero*, from Fr. *flibustier*, *fribustier* (with silent *s*), from Dutch *vrijbuiter* (whence also Eng. *freebooter*); *vrij*, free + *buit*, booty, plunder]: a buccaneer or pirate. In 1849 and 1851 the name was applied by the Cubans to Narciso Lopez and his followers, and from that time it became a common name in the U. S. for the military adventurers who have fitted up expeditions from that country against the Spanish-American states. The most famous of the filibusters have been Lopez, above mentioned, and William Walker, who invaded Sonora, Mexico, in 1853, and afterward three times attempted to make himself master of Nicaragua: 1855–57, in 1857, and in 1860. See LOPEZ, NARCISO, and WALKER, WILLIAM.

Filicaja, fē̆e-lē̆e-kaa'yā̆a, VINCENZO, da: Italian poet; b. at Florence of a noble family, Dec. 30, 1642. Even in youth his ardent temperament was controlled by a clear judgment and high principles, and he returned to Florence, after his student-life at Pisa, with the character of an accomplished scholar and an earnest, upright man. Eminent as a jurist, and even consulted as a theologian, he occupied every leisure hour with poetry, and when at the age of thirty-one he married into the great Capponi family and was made senator by the grand duke, he was already known in Italy as a poet of distinguished genius. His noble *canzone* addressed to John Sobieski on occasion of the raising of the siege of

Vienna in 1683 caused his name to be known throughout Europe, and kings and emperors congratulated and honored him. His sonnets are models of purity of style, of vigor, and of sublimity of thought. Among the most celebrated of these are *La Providenza*, a sonnet of exquisite beauty, and *L'Italia*. The translation of the latter, introduced by Byron into the fourth canto of *Childe Harold*, and beginning with "Italia! oh Italia!" etc., is familiar to English readers. Filicaja held positions of high trust, and his life was in noble accord with the lofty sentiments of his poems. Tiraboschi says that "he died deeply lamented alike by rich and poor, and beloved by God and man." D. Sept. 24, 1707. See Tiraboschi, *Storia della letteratura Italiana*; Fabbroni, *Vite Italiane*; Crescimbeni, *Vite degli Arcadi*.

Filices [from Lat. *filix*, a fern]: See Fernworts (Filicinæ).

Filicinæ: See Fernworts.

Filioque, fil-i-ō'kwē [Lat., and from the son; *fi'liō*, ablat. of *fi'lius*, son + enclitic particle *-que*, and]: the clause of the Nicene Creed in its Western form which teaches the procession of the Holy Spirit from both the Father and the Son. The Council of Nice (325 A. D.) affirmed the consubstantiality of the Son with the Father, and simply declared its belief "in the Holy Spirit." The Council at Constantinople (381 A. D.) affirmed, in effect, the consubstantiality of the Spirit with both the Father and the Son, and taught the procession of the Spirit "from the Father." It was not affirmed that the Spirit proceeds from the Father *only*, but it became at last the established doctrine of the Greek Church. But at first the Greek Fathers were not agreed. Athanasius (d. 373), Basil (d. 379), and Gregory of Nyssa (d. after 394) were non-committal, neither affirming nor denying the procession of the Spirit "from the Father *and the Son*" (*filioque*). Marcellus of Ancyra (d. 373, 374), Epiphanius (d. 403), and Cyril of Alexandria (d. 444) affirmed it. But it was denied by Theodore of Mopsuestia (d. 429), and by Theodoret of Cyrus (d. 457–458). And this, as has been said, is the view which finally prevailed in the Greek Church.

In the Latin Church, on the other hand, the double procession of the Spirit appears never to have been denied. In St. Augustine's treatise on the Trinity, which was written between 400 and 416 A. D., it is clearly and emphatically taught that the Spirit proceeds from both the Father and the Son. And so firmly did this become the established doctrine in the West, that at the third synod of Toledo in Spain (589 A. D.) the clause *filioque* was added to the Niceno-Constantinopolitan Confession, and the doctrinal basis was laid for the schism—urged on by other influences—which permanently separated the Churches of the East and the West.

In the East the orthodox doctrine, confirmed by the influence of John Damascenus (d. between 754–787), rejected from the Creed the *filioque*; while in the West, at a synod convened by the Emperor Charlemagne, the introduction of the phrase into the Creed was indorsed especially through the influence of Alcuin, Theodulph of Orleans, and the Frank theologians. Pope Leo III. had already expressed his approval of the doctrine which the term implied, while he hesitated to approve its introduction into the Creed. He regarded it rather as speculative than practical. At length, when, in the ninth century, the controversy arose between Photius, Patriarch of Constantinople, and Nicholas I., which led to the rupture between the Churches, the doctrinal difference was made a topic of discussion, and the Western Church was reproached with having departed from the faith. Its position was defended by Æneas of Paris, Ratramn of Corvey, and especially by Anselm, Archbishop of Canterbury. In 1274 A. D. an attempt was made at the Council of Lyons to effect a reconciliation, but the effort proved futile. In 1439 A. D., at the Council of Florence, the attempt was renewed, but the formula proposed did not secure acceptance, although theologians of both parties were present, and had full opportunities to confer together. Plans of union between the two Churches have repeatedly been suggested, and hopes have been cherished that the breach might be healed. Possibly it might, if the question at issue had been limited to the phrase *filioque*, but in each instance in which its merits have been discussed other influences have operated to prevent the reunion. Although other characteristic differences separate the two Churches, their diverse views of the *filioque* have become historically the most conspicuous, if not the most important. The two Churches are equally committed to the maintenance of the doctrine of the Trinity. See Procession of the Holy Spirit. Revised by J. J. Keane.

Filipepi, Alessandro, called **Sandro Botticelli**: painter; b. in Florence, 1474. He took the name Botticelli from his first master, a goldsmith, but his teacher in painting seems to have been Fra Lippo Lippi (see Lippi). The earliest pictures of his which have been preserved are Madonnas of a melancholy and perhaps morbid expression of face; and a very peculiar slenderness of limb and remarkable type of head was characteristic of him, although not wholly unlike the work of his great contemporary, Ghirlandajo (*q. v.*). Before 1480 Filipepi had painted a remarkable *Birth of Venus*, now in the Uffizi Gallery of Florence, the *Adoration of the Three Kings*, in the Academy of Florence, and the large picture in the same gallery called *The Triumph of Spring*, *The Triumph of Venus*, and by other names. The last-named work is of mystical subject; it contains many figures, and is a very characteristic work of the Italian Renaissance. In 1480, in the Church of the Ognissanti at Florence, he painted a fresco of *Saint Augustine*, which still remains. At this time he was invited to Rome, and before 1484 he had painted on the walls of the Sistine Chapel several large frescoes, which still exist. Drawings of his exist illustrating the great poem of Dante, and he is thought to have engraved some of his own designs, many of which were probably followed by Baccio Baldini and other engravers. Botticelli's work from 1484 to his death is but little known, but he seems to have lived in Florence. In his prime he shared with Ghirlandajo the credit of being at the head of Florentine painting, and all the tendencies of advance and development of the epoch are to be seen in his work. D. at Florence, 1515. Besides the works named above there are many in the galleries of Europe, as, in the Pitti, Florence, a *Virgin with the Child and St. John*, and a portrait called *La Bella Simonetta*; in the Borghese Gallery, Rome, one of the fine circular *Madonnas* which he affected; in the Turin Gallery, a large allegorical picture and several smaller ones. Russell Sturgis.

Fil'lan (Irish, *Faelan*): the name of two saints, of whom the one has his festival on June 20 and his principal churches at Ballyheyland, Queen's County, Ireland, and at Loch Earn, Perthshire, Scotland; while the other has his festival on Jan. 9, and his principal churches at Cluain Maosena, Westmeath County, Ireland, and at Strathfillan, Perthshire, Scotland. The legend of the latter is found in *Act. Sanct.*, Jan. 9, tom. i., and in A. P. Forbes, *Kalendars of Scottish Saints* (Edinburgh, 1872, pp. 341–46). See also John Stuart, *Historical Notices of Saint Fillan's Crozier* in *Proceedings of Soc. Antiq. of Scotland* (1878, xii., 122–82).

Fillmore, John Comfort, A. M.: musician; b. at Franklin, Conn., Feb. 4, 1843; educated at Oberlin College and Leipzig Conservatory of Music; director of the Conservatory of Music, Oberlin College, 1867–68; Professor of Music, Ripon College, 1867–77, and at Milwaukee College for Young Ladies 1878–84; organized the Milwaukee School of Music 1884. Author of *History of Pianoforte Music* (1883); *New Lessons in Harmony* (1886); *Lessons in Musical History* (1887).

Fillmore, Millard: the thirteenth President of the U. S.; b. of New England parentage in the town of Sumner Hill (then a part of Locke), Cayuga co., N. Y., Feb. 7, 1800. He worked in youth upon his father's farm in Sempronius (now Niles) in the above county, and when fifteen years of age was apprenticed as a wool-carder and cloth-dresser. His school-education was scanty, but his leisure hours were occupied with study. He undertook when nineteen years of age the study of law with Judge Wood, of Montville, N. Y., teaching school a portion of the time. In 1822 he removed to Buffalo, N. Y., was admitted to the bar in 1823, and opened a law-office in East Aurora, N. Y.; commenced practice in the State Supreme Court in 1827, and in 1830 removed to Buffalo, where he became a partner of Solomon G. Haven and Judge Nathan K. Hall. He was sent to the New York Assembly 1829–32; was in Congress 1833–35 and 1837–41, where he was an active and useful member, favoring J. Q. Adams's views upon slavery, and in other public questions acting mainly with the Whigs. While chairman of the committee of ways and means he took the leading part in drawing up the tariff of 1842. In 1844 he was the Whig candidate for Governor of New York; in 1847 was chosen comptroller of the State and resigned in 1849; in 1848 was chosen Vice-President of the U. S. on the ticket with Gen. Taylor. On the death of the latter, July 9, 1850, Mr. Fillmore became President. The great events of his administration were the passage of the Compromise Acts of 1850 and the Japan expedition of 1852. Mr. Fillmore was in Europe 1855–56, and in the latter year was the candidate of the American party for the Presidency. He did not again enter public life. D. Mar. 8, 1874.

Filmer, Sir ROBERT: political writer; b. at East Sutton, Kent, England, toward the end of the sixteenth century; educated at Cambridge; d. about 1653. He was the most prominent of the early expounders of the DIVINE RIGHT THEORY (*q. v.*), which he presented in its most extreme form, asserting the absolute freedom of the king from human control. The *Patriarcha*, published after his death (1680), contains the most complete exposition of his views, and was answered by Locke in his *Treatise on Government*. Filmer also wrote *The Anarchy of a Mixed and Limited Monarchy* (1646); *The Power of Kings and in Particular of the King of England* (1648); and *Observations upon Mr. Hobbes's Leviathan, Mr. Milton against Salmasius, and H. Grotius De Jure Belli et Pacis, concerning the Originall of Government* (1652).

Filoplumes [from Lat. *filum*, thread + *pluma*, feather]: See FEATHERS.

Filter: See WATER.

Filth Diseases: a term introduced by Mr., now Sir, John Simon, in his report as medical officer of the Privy Council and Local Government Board of Great Britain, made in 1874, to include certain forms of disease upon whose prevalence and spread in a community he supposed the presence of putrescent refuse matter, solid and fluid, to exert a great influence. Among these diseases he included typhoid fever, cholera, dysentery, and various forms of diarrhœal disease, and also referred to septic diseases, such as erysipelas, pyæmia, puerperal fever, and septicæmia, as spread by the same cause. By "filth" in this connection is meant more especially human excrement and putrefiable garbage and refuse accumulated in, or in the immediate vicinity of, human habitations, either lying on the surface or stored in dust-bins, cesspools, privy vaults, obstructed or badly graded sewers, and the like. From such accumulations Mr. Simon held that "two chief sorts of danger to life arise: one, that volatile effluvia from the refuse pollute the surrounding air and everything which it contains; the other that the liquid parts of the refuse pass by soakage or leakage into the surrounding soil, to mingle there of course in whatever water the soil yields, and in certain cases thus to occasion the deadliest pollution of wells and springs." It is doubtful whether Mr. Simon supposed that either the filth itself or the ordinary volatile products of putrefaction were the active causes of the specific infectious diseases to which he referred, but such has no doubt been the opinion of many persons who accepted his teachings, and it is a very common idea that accumulations of filth are in themselves sufficient to generate epidemic diseases, and that not only typhoid fever, but also diphtheria, yellow fever, and even scarlet fever, may thus arise *de novo*. Discoveries in bacteriology and the application of exact methods of research have shown that the importance of filth as a causal factor in the production of disease consists mainly in two facts—first, that it furnishes a good medium for the growth and multiplication of certain forms of pathogenic bacteria when these gain access to it; and, second, that sooner or later such bacteria are very likely to find their way into it.

Of the micro-organisms which produce disease, some, such as the bacillus of typhoid, can grow and multiply in dead organic matter at ordinary temperatures, and a few of them may thus in the course of a few days make all parts of a foul solution dangerous, while others, such as the bacillus of tubercle, require temperatures near that of the living body for development, and hence under ordinary circumstances do not make accumulations of filth infectious. Although smallpox, scarlet fever, diphtheria, measles, and typhus may be conveyed by foul clothing or bedding, yet their spread is usually in no way connected with accumulations of filth, nor are they generated *de novo* by such accumulations. Typhoid fever is the typical filth disease, in the sense that it is mainly transmitted through human excreta, yet there is no evidence that a cesspool or water-supply can become the cause of this disease in any other way than by having the specific bacillus of typhoid added to it. It is possible that a common and under ordinary circumstances harmless form of bacillus may, in the course of time and under special conditions of food and temperature, be so changed in nature and functions as to be capable of producing a transmissible disease, but it is very improbable that such a change gives rise to the ordinary forms of specific disease as seen in practice.

The idea that specific disease of any kind is produced by gases or volatile products of any kind given off by decomposing filth is now generally abandoned, and it is known that the micro-organisms which cause such diseases do not pass into the air from the surface of fluids or from moist surfaces by simple evaporation. They are carried into the air by spray or dust, but not otherwise. Whether yellow fever is a filth disease, in the proper sense of the term, is as yet uncertain, but it is prudent to act on the supposition that its specific germ may be preserved in, and have its powers for evil intensified by, accumulations of human excreta and by water polluted with such excreta.

The various forms of septic disease, including puerperal fever and those produced by pyogenic organisms, are often due to want of cleanliness of the person, of clothing, of instruments, etc., and such want of cleanliness is apt to occur in connection with or to be produced by the presence of accumulations of filth, and in this sense they may perhaps be called filth diseases. The name "finger-nail fever," which has been applied to puerperal fever, is a very suggestive one.

Filth diseases are to be prevented, as Simon remarks, by preventing accumulations of filth rather than by trying to disinfect such accumulations, and one of the most important means of doing this for a city is a proper system of sewerage, which involves a good general water-supply and the regulation of the drainage systems in individual houses to insure proper connections and prompt disposal of liquid wastes. J. S. BILLINGS.

Fi'lum A'quæ [Lat., liter., a thread of water; *fi'lum*, thread + *a'quæ*, gen. of *a'qua*, water]: in law, an imaginary line passing along the middle of a river and dividing the soil underneath into two equal portions. In navigable streams above the point where the tide ebbs and flows, and in all streams which are not navigable, the *filum aquæ* designates the boundary to which the lands of owners along the river extend. If a grant be made of land adjacent to a river, it includes the soil to the center of the stream, unless the terms of the grant clearly indicate a contrary intention. If an island forms in the river so as to be divided by the *filum aquæ*, the parts thus separated belong respectively to the opposite proprietors. If there be a gradual deposition of earth upon one bank, and none or little upon the other, the thread of the stream will constantly vary, so as to always be midway between the banks. But if a large portion of land be detached from one side and carried to the other, the thread remains as before, so that the estate of each owner may extend to the same limits as previously. If a single person owns the land on both sides of a stream, of course the entire bed is also his sole property.

The *filum aquæ* in all cases only denotes the ownership of land forming the bed of a river or rising above the surface, but does not indicate any exclusive proprietary right in the water which is thus supposed to be divided. Each riparian owner along the whole course of the stream has a right to have the water flow in its accustomed manner and volume, and no one of the owners is justified in diverting the stream to his own uses, or in so materially diminishing the water-supply which it affords as to occasion unreasonable injury to the others. But any use of the water, as for purposes of irrigation, etc., which does not sensibly impair the rights of such other persons, is allowable.

In the case of public rivers, or those in which there is a flow of tide water, the soil underneath does not belong to adjoining owners, but to the sovereign or state, so that the doctrine of the *filum aquæ* has in general no application. It may, however, denote the boundary-line between two different States or two different counties. In some parts of the U. S. the doctrine is maintained that though there is no tide, the bed of a stream which is in fact navigable belongs to the State, and not to the riparian owners. See THE LAW OF RIVERS under the title RIVERS.

GEORGE CHASE.

Fin [M. Eng. *fin*, *finne* < O. Eng. *finn*: Germ. *Finne* < Teuton. *finna*: Lat. *pin'na*, fin, wing]: the principal organ of locomotion in fishes. A fin consists of a membranous expansion of the body, supported by bony spines or cartilaginous rays. Fins may be either median or paired, according as they lie in the middle line of the body or occur right and left of the median line. The median fins are the dorsal, caudal, and anal, the names of which sufficiently indicate their position. The paired fins never exceed four in number—a pair of pectoral fins, homologous with the fore limbs, and a pair of ventrals, with the hind limbs of higher vertebrates. The size and position of the fins may vary greatly, and these modifications are utilized in classifying fishes. Recent research tends to show that fins are derived from two lateral folds on either side of the body. The dorsal fold on either side moves upward and unites in the dorsal fin, while the lower fins behind the vent move downward in the same way, forming the anal, while the caudal fin is formed by both folds. The paired fins are portions of the lower fold, which continue to develop while the rest disappears. That this view is correct is shown, among other facts, by the Japanese goldfish, in which frequently both anal and caudal fins are paired. From structures similar to the paired fins have been derived the locomotor appendages of the higher vertebrates. J. S. KINGSLEY.

Final Causes: causes (see CAUSE) which are not also effects. All other causes are, on one side, caused; they come forth as well as go forth. Final causes do not come forth. The physical sciences, as such, have nothing to do with final causes. When they exhaust physical causes, they exhaust all with which they have to deal, for physical science is the science of second causes. They assume the simples and forces as existent, and the question *how* these simples and forces came to exist is not for them. In this sphere the objection of Bacon and Descartes to the investigation of final causes is well founded. It was too often an indolent or ignorant evasion of the real work of science. But, as it is no part of the distinctive work of physical science to determine final causes, it is equally remote from its province to assert that there are not final causes. The whole doctrine of final causes has been denied by materialism. (See Strauss's *Old Faith and New Faith*.) Ulrici shows that the argument of materialism at this point rests upon a confounding of "the *notion* of causality with the *mental law* of causality," and that the law of causality "does not affirm that whatever *exists* must have a cause, but only that all that *happens*, all that *comes into being*, must have a cause." See Ulrici's *Review of Strauss*, with an introduction by C. P. Krauth (1874), pp. 86–91, and pp. 56–58.

Finance [from O. Fr. *finance*, revenue > Fr. *finance*, finance : Ital. *finanza* < Low Lat. *finan'cia*, payment, money, deriv. of *fina're*, pay a fine, deriv. of *fi'nis*, settlement, fine, Class. Lat. *fi'nis*, end]: in general, pecuniary management, or the science of monetary affairs; in a strict sense that branch of the science of economics which treats of public revenue and expenditure. Finance in the latter sense has grown in dignity and importance as a separate department of the science of economics with the modern increase of government expenditure. The fact that $6,000,000,000 or over are annually received and spent by the national governments alone throughout the world indicates the far-reaching importance of this science.

Public Expenditure.—Government expenditure is naturally divided into *ordinary* and *extraordinary* expenditure. The former are the running expenses of government, which recur at stated intervals, and can readily be foreseen and calculated. The latter cover those expenses which the government may be suddenly or unexpectedly called upon to incur, or it covers investments of capital the returns or benefits of which are spread over a number of years. This distinction is important when taken in connection with the accepted principle of finance, that ordinary expenditure should be met with ordinary revenue and extraordinary expenditure with extraordinary revenue. In practice a proper distinction from this standpoint is often made with difficulty. Thus the cost of new men-of-war, of building custom-houses or schools, might be classed as items of extraordinary revenue, when in fact such items should be included among the government's running expenses in keeping its plant up to the proper standard. In the accounts both of corporations and of governments the tendency is strong toward apparently reducing ordinary by charging as much as possible to extraordinary expenditure. The distinction between *fixed* and *varying* expenditure is important as bearing on the powers of the legislative body which decides upon the spending of the public money. Fixed expenditure, as the name indicates, is fixed by an act of the legislature either permanently or for a series of years, such as the salaries of certain officials, or the expense of meeting the interest on the public debt; in a word, those expenses which need not or ought not to come up for revision at every legislative session. Varying expenditure is determined at each session of the legislative body, such as the cost of public improvements. A further classification of public expenditure is made according to the political unit which such expenditure concerns. Thus in the U. S. it is divided into *Federal* (national), *State*, and *local* expenditure, according as it concerns national, State or local interests. The Federal sphere of expenditure refers to those interests which all the States of the Union have in common; such are the preservation of the sovereignty of the U. S., to which the expense of maintaining army and navy is incident, and the cost of foreign intercourse. These items together formed 70 per cent. of the total Federal expenditure during the fiscal year ending June 30, 1891, which was as follows:

For army	$48,720,065
Navy	26,113,896
Pensions	124,415,951
Interest on debt	39,865,425
Foreign intercourse	2,028,715
Indians	8,527,469
Civil expenses	27,143,925
Miscellaneous expenses	67,035,740
Total ordinary expenses	$343,851,186

The civil expenses include particularly those of the executive, legislative, and judicial departments; the miscellaneous include particularly the cost of public buildings and public improvements, the cost of collecting the revenue, and the deficiency in the post-office revenue.

The sphere of State expenditure in the U. S. concerns interests which in general do not reach beyond the limits of the State, and are not purely local in character. The following table of the ordinary expenditure of the State of New York during the fiscal year 1891 is fairly representative of the expenditure of the other States, except for the unusual amount spent for educational purposes by New York:

For administrative departments	$789,183
Legislature	411,964
State judiciary system	670,375
Public works and buildings	2,373,590
Militia	530,214
Asylums and charitable institutions	2,571,582
Prisons and penitentiaries	749,723
Public education	4,577,615
Agricultural interests	212,528
Interest on the State debt	263,492
Moneys refunded	68,741
Miscellaneous expenses	111,130
Total ordinary expenditure	$13,330,137

Beside the Federal and State expenditures a local sphere of public expenditure is found in the minor political units, namely, in the counties, townships, boroughs, parishes, school districts, villages, and, most important of all, in the cities. The relative importance of these minor political units differs in different sections of the country. In the New England States the township is the most important; in the Southern States the county is more important; in New York and most of the Western States the so-called "compromise system" prevails, in which political power is more evenly divided between the county and the township. The ordinary expenses of the city and county of New York during the fiscal year 1891 were as follows:

For cost of administration	$2,123,387
City courts	1,461,060
Police	4,773,188
Asylums and charitable institutions	3,275,369
Public education	4,497,337
City parks	966,807
Streets and public works	5,802,592
Fire department	2,238,406
Judgments	730,657
Interest on city debt	5,084,804
Redemption of city debt	1,307,599
Miscellaneous expenses	444,460
Total ordinary expenditure	$32,705,666

These spheres of public expenditure in the U. S., the local, State, and Federal, do not find their exact counterpart in other countries. However, the expenditure on the one hand of a nation and on the other hand of a city are in general alike in character the world over, the former affecting the widest, the latter the narrowest public interests.

Budget.—A budget is an official forecast of public expenditure and revenue, on which the money-raising and money-spending laws are based—official, in the sense that it is made by a government official, the head of the government finances. A forecast of the public revenue and expenditure must be based on the experience of the past, and presupposes a review of the financial measures of the preceding fiscal years. Under constitutional governments the budget is of the greatest importance in the diets and the other representative bodies, where it is discussed and criticised by the legislators who control the appropriation of public money and devise means of raising public revenue. The leading example of budget legislation is found in Great Britain. The British Parliament controls all fiscal measures of the Government, but never originates them. The Chancellor of the Exchequer, the head of the Government finances, offers to the House of Commons his budget or estimates for the ensuing fiscal year, in the shape of a full statement of the amount of money required by the Government, and of his plans for meeting that expenditure. The spending and raising bills are discussed in committee of the whole, the Chancellor defending the proposed measures by reference to the experience of former years; the bills may be slightly amended, and after their passage in the House of Commons generally receive the approval of the House of Lords, which can only reject or accept them.

In the case of the U. S. Congress, the Secretary of the Treasury, a member of the cabinet, and head of the Federal finances like the British Chancellor of the Exchequer, sends his estimates to the Federal Congress. They are introduced in December, from six to seven months before the beginning of a new fiscal year on July 1. The Secretary of the Treasury, though responsible for the carrying out of the fiscal laws passed by the Congress, has but a small share in shaping those laws. He may be called upon to testify as to some item in his estimates before a committee of either house, but the financial policy of the Government is entirely in the hands of the Congress and of its committees. The money-spending and money-raising bills are framed by the committees irrespective of the Secretary's wishes, the committees, moreover, acting independently of each other. Money-raising bills must, and money-spending bills usually do, originate in the House of Representatives. After passing this lower house the bills are sent to the Senate for approval. There they are handled by similar committees, and are generally amended and returned to the House of Representatives for reconsideration. Finally, the bills pass both houses in the same form through the intervention of a so-called "conference committee," if they are otherwise unable to agree, and if approved by the President, become laws. The fiscal legislation of the States is similar to that of the Federal Government. In the lesser political units it lies more in the hands of the heads of counties, townships, etc., to frame the local fiscal laws under the supervision of the people's representatives, as, for instance, of the common council and board of aldermen in the case of cities.

In the finances of the U. S., Federal, State, and local alike, the carrying out of fiscal measures is in the hands of three distinct departments: The *director's* department, comprising the Federal Secretary of the Treasury and his assistants, the State and city comptroller, etc. These officials execute the fiscal laws, and draw warrants for the payment of public expenditure which are honored by the *cashier's* department, the treasurer, or chamberlain, who have direct charge of the public funds. The *auditor's* department verifies the warrants and claims, in a word, the public accounts. The accounts of the States and lesser units are complicated by the system of so-called *funds*. These are divided into *investment funds* and *account funds*. Investment funds are accumulations of money in the State or local treasuries, invested productively in bond and mortgage or otherwise, the interest being generally devoted to some special object. The school funds in various States are a leading example. Account funds are merely the names given to various accounts or divisions in government bookkeeping. The levee fund or the street fund is thus credited with the amounts appropriated for that particular purpose and debited with the amounts spent on those objects, and so with other account funds. The *general fund* has grown to be the most important, and includes all the items not embraced by the others. A further complication in the State and local public accounts in the U. S. arises from the fact that large transfers are frequently made in them from one account fund to another, and from an account fund to an investment fund, or *vice versa*, to supply a deficiency in one or the other.

PUBLIC REVENUE.—The expenditure of governments is met by their revenue. The sources of public revenue are domains, business enterprises, dues, taxes, and loans, the first four comprising the ordinary, the last the leading item of extraordinary public revenue.

Domains.—These are the public lands owned and managed by the various governments. The net receipts from this source, if they exist, figure among the receipts of the governments. In European countries the domains consist largely of forest lands; these are rented at such rates, or their products are sold at such prices, that they net the national or local treasuries considerable sums: in Bavaria, for instance, 11 per cent. of the total ordinary revenue; in Prussia, 5 per cent. Other than fiscal motives may lead to the retention of government domains, such as the desire to preserve the forests, or the desire to encourage agricultural settlers. The latter outweighs the fiscal motive in the U. S., and in consequence the immense tracts of Government lands have never proved a remunerative investment. From 1784 to 1883 the Federal Government spent $352,000,000 on the purchase, survey, and administration of the public lands; during the same period the receipts from the sale of land aggregated $234,000,000. Hence the Government has done a losing business with its land. Instead of disposing of it in such a way as to recover the amount it cost to acquire and manage it, the Government has pursued the policy of disposing of its land at such low figures that the investment has proved unremunerative. The desire to encourage the settlement of the West has been uppermost in Federal land legislation. The pre-emption, homestead, and bounty laws had disposed of 337,000,000 of acres up to 1883; grants of land in aid of road, canal, and railway construction, and grants to the individual States in aid of schools and colleges, took in addition 234,000,000 of acres. The public domain originally contained 1,849,000,000 of acres, of which it is estimated 620,000,000 had been disposed of prior to 1883, at an average price of $38\frac{3}{10}$ cents per acre. In the finances of the States and lesser units in the U. S., public land is similarly unremunerative, and though some cities own considerable amounts of real estate, the revenue derived from leasing or selling it is never large. This is not so much due to the influence of other than fiscal motives, as in the case of the Federal Government, but owing to careless management, the land being leased at low figures and for long terms of years.

Government Business Enterprises.—The second class of government revenue, that from business enterprises, is best represented by the operations of the *post-office*, which in all civilized countries is now a government monopoly. The penny post reform of Rowland Hill in Great Britain, beginning with the year 1840, was decisive in its influence on the postal policy of various nations. In accordance with Hill's recommendation the hitherto exorbitant charges for transporting letters were lowered to a uniform rate of one penny per letter for all distances within the United Kingdom. As a result of this change, the business transacted by the post-office increased enormously, but the net revenue fell off and did not reach the figure at which it stood prior to the reform until 1872. The postal reform of Great Britain has been copied in turn by every civilized nation. In the U. S. the policy of cheapening postal charges outweighs the fiscal consideration of deriving a net revenue from the post-office. Prior to 1841 the gross revenue exceeded the expenses of the post-office, but since 1852 the annual expenditure has exceeded the annual revenue. These ever-recurring deficits have been due to the cheapening of postal rates and to the necessity of supplying an enormous and thinly populated territory with postal facilities.

During the fiscal year 1891 the gross revenue of the Federal post-office amounted to $65,908,909; the total expenditure during the same year amounted to $72,069,115, resulting in a deficit of $6,160,205. While the post-offices in the New England and Middle States netted the Government $6,000,000, those in the other sections of the country did a losing business to the extent of $12,000,000. The post-offices of other countries, which are more favorably situated and which have pursued a less radical policy in fixing postal rates, have fared better and net the governments large sums. The policy of deficit financiering in the post-office is unjust in that the deficit is borne by the Federal taxpayers who are not coextensive with those who enjoy the benefits of cheap postage rates. The argument that the latter are desirable as an educational means—that is, as an encouragement to reading and letter-writing—has little weight, for those who gain by such cheap rates are, after all, but a small class of the population, and they enjoy the favors granted them at the expense of the body of taxpayers. The least the taxpayer can fairly ask for is that the postal revenue shall be made to equal the expenditure of the post-office. This does not mean, however, that postage rates shall be fixed strictly according to the cost of service, which is impossible, both on account of the need of simplicity and of uniformity of rates for the same kind of mail matter between all points within the country, and on account of the impossibility of calculating the cost of transporting the various classes of mail matter. Just as in the case of railway rates, so in general postage rates are fixed "according to what the traffic will bear," which in the long run has proved the easiest principle to realize in practice. Thus the Government charges two cents for transporting a letter weighing 1 oz., and one cent for transporting periodicals weighing 1 lb., not so much because it costs less to transport a periodical than a letter, as because any decrease of the former and increase of the latter rate would materially curtail the circulation of periodicals by the post-office and would not correspondingly increase the use of the mails by letter-writers.

Other forms of government business enterprises are found in the finance of European nations. Such are the *government telegraph* and *telephone* service, government *railways*, the manufacture of tobacco, powder, and matches, and government lotteries, *monopolies* which net the various governments more or less above their running expenses. In France $120,000,000, one-fifth of the ordinary revenue, are annually derived from the post-office and other Government monopolies, such as the manufacture of matches, tobacco, and explosives. In the U. S. the leading Government business enterprises, besides the Federal post-office, are the prisons and penitentiaries, the canals and highways when owned by the State or local governments, and the gas and water works of municipalities. None of these have ever proved a great success financially. One more business activity on the part of governments should be mentioned, that of lending their accumulated funds. Thus the investment funds of the States of the Union generally consist of municipal or other Government bonds, or of bonds and mortgages, the interest on these investments flowing into the State treasury.

Dues.—The next class of government revenue is included under the head of dues or fees—namely, *special* remunerations for *special* government services. Where the benefit of government to an individual is special in character and can be measured, he is charged a due or fee, that is, an amount equal to the cost of that service, but where the benefit of government is general and can not be measured in the case of an individual, taxes are raised—namely, *general* remunerations for *general* services. Coinage fees, court fees, and market fees are examples of such dues paid by individuals in return for special services done them by the government. The leading example of dues in the U. S. are the so-called *local assessments*, dues paid by real-estate owners for the rise in value of their property, owing to some action on the part of a municipal government. A city lays out, paves, and curbs streets, builds bridges, sidewalks, and parks, provides for street lighting, sewers, and water-mains. The adjoining real estate is increased in value thereby, and the owners of this real estate are fairly called upon to bear the expense of the improvement, as it specially benefits them and only incidentally benefits the public at large. In carrying out the principle that the cost of such improvements should be borne by the land-owners benefited, some standard on which to base the distribution of the cost must be adopted. This may be the assessed value of the property in question, or the same with due regard to its distance from the improvement, or it may be the frontage of the property on the street in the case of a street improvement.

TAXES.—The next class of government revenue, taxes, have little in common with dues or local assessments. Taxes are not special remunerations for special services; they are general forced contributions toward the support of the government—"general" in the sense that they are not based on any special relation the taxpayer may bear to the government, "toward the support of the government" in the sense that they are not payments for some particular acts on the part of government officials, but are contributions toward the cost of exercising those various functions which we call government, whose benefits are general and can not be measured by their effect on the individual, and can not be paid for accordingly. Taxes are not the equivalent of the protection the government gives the taxpayer; they are not insurance premiums against harm done to persons or property. The historical development of government revenue has in general followed the classification here given. At first the domains, the landed property of the sovereign, were sufficient to defray the expenses of the government, that is the court's expenditure. When they failed, business enterprises, monopolies of various kinds, were introduced. Then followed dues generally in the shape of licenses to trade. When all these failed to supply the growing wants of the modern bodies politic, general contributions were enforced. Thus taxes were originally an unusual or extraordinary means of raising revenue, necessary because the other means failed. The individual subject deemed it almost an infringement of his rights to be asked to contribute toward the cost of supporting the government, which he thought should be primarily borne by the private revenues of the crown. The *subject* has become the *citizen*, an organic part of the government; the people legislate and the people pay taxes, which have now become the primary means of revenue, while the others have lost in relative importance and have sunk to an insignificant figure in the U. S. Every individual, as a component of the body politic, pays taxes, not in virtue of a contract he enters into with the government, whereby he assures himself protection in return for the taxes he pays, but in virtue of the fact that he is born into a civilized community and thereby involuntarily has the obligation of paying taxes forced on him. It is a long step forward from the "voluntary contributions" of American colonial days to the complications of modern tax systems, with all the refined machinery for preventing evasion and enforcing the payment of taxes. With the growth of taxation has gone hand in hand the development of the last class of public revenue, of public loans. With the power to tax has come the power to borrow. A government which is successful with its tax system enjoys the confidence of the lending public: its credit is good, it can borrow on favorable terms whenever the occasion may arise.

Taxes are classed as *direct* and *indirect*. A tax is direct when it falls on the original or first payer; it is indirect when the original payer indemnifies himself at the expense of others. This distinction is one in economics, not in law. By constitutional provision, Federal direct taxes in the U. S. must be apportioned among the States according to their population. In the early history of the Federal Supreme Court it was held that only poll taxes and land taxes were direct in the meaning of the constitution. According to later decisions, taxes on income, on the note circulation of banks, and on inheritances, were held not to be direct. Such taxes, if direct, would have to be apportioned among the States, which would make their collection difficult, unfair, and in many cases impossible. A leading example of a direct tax, in the proper economic sense, is an income tax, which rests on the first payer and can not be shifted by him on others by charging more for his services; an example of an indirect tax is an import tax, which, though primarily paid by the importer, is shifted by him to the dealer in the advanced price of the article, and finally rests on the consumer. The distinction of direct and indirect taxes is a vital one, for on it depends the answer to the question of the *incidence* of taxation—namely, the question, who finally bears the burden of any particular tax or system of taxes. (See TAXATION.) Another important distinction is made between a real tax, one directed at a *thing*, and a personal tax, one directed at a *person*. As a matter of fact, of course, only a person can pay taxes; still in the finance of the U. S. the distinction is of great importance between taxes directed at a person as a taxpaying individual and those directed at things as representing an amount of wealth of which a certain part is claimed by the tax. The poll tax of the U. S. is eminently a tax on persons, the State and local property tax a tax on things; the former has only the personality of the taxpayer, the latter the extent of his property in view. The most useful classification of taxes divides them into those on *consumption*, or on what the taxpayer spends, on *revenue*, or on what he earns, and on *possession*, or on what he owns.

Taxes on Consumption.—These can rarely be levied on the consumer directly. The leading exception is the tax on householders. Such a tax is levied upon householders, whether owners or renters, and is proportionate to the amount of house rent paid. It is a tax on one line of consumption, and has been adopted by German cities in their systems of taxation, Berlin raising two-fifths of its ordinary municipal revenue in that way. Its advantages lie in the facts that it is easily assessed and collected, and that it is a tax on a person, directed at the householder as a member of the community, and not at his real property, a thing; its disadvantage lies in the difficulty of so framing the tax as not to unfairly burden the poorer classes, to whom the relative amount paid for house rent means much more than it does to the well-to-do classes. Instead of levying a tax on householders in proportion to the rent they pay, the tax may be based on some other criterion. For instance, the French door and window tax (*contribution des portes et des fenêtres*) taxes householders in proportion to the number of doors and windows their house contains. The use of some such external criterion avoids the necessity of inquisitorial methods in getting at the exact amount of house rent in each case.

Taxes on consumption levied on the dealer, with the intention of having him make good his loss in the price he charges the consumers, are of wide application in the U. S. So-called licenses are included under this head. A license, as the name indicates, involves a permit to carry on a certain trade or profession. When pedlers are required by law to take out a license to enable them to carry on their trade, it is done partly to keep this class of itinerant merchants under surveillance, to know their whereabouts and doings, and incidentally to limit their number; but, on the other hand, it is partly done as a means of revenue. The system of trade licenses has been adopted throughout the States of the Union, particularly in the Southern States, where license taxes, occupation taxes, business taxes, and privilege taxes net the State governments a large part of their ordinary revenue, in Mississippi 14 per cent., in Texas 33 per cent. In the North retail dealers in liquors and beers are particularly affected by the system of licenses. The cities derive large sums from this tax on consumption, New York, for instance, $1,500,000; but the municipal treasury is not benefited by this large revenue from liquor licenses, for on some theory of retribution the law provides that this revenue shall be distributed among the benevolent and charitable institutions of the city. All such license taxes have certain fiscal advantages in being easy to collect. However, in the U. S. their extension has been much hindered by the judicial interpretation of the Federal Constitution. In the first place it has been held that a license tax required for the sale of goods is in effect a tax upon the goods themselves. From this decision the step was easy to the one which held certain State license taxes unconstitutional, because they infringed upon the right of the Federal Congress to regulate commerce between the States. The trend of the decisions on this question has been toward a strict construction of the constitution, and the latter's interpretation now limits the levying of State and local licenses to businesses strictly within the State—that is, domestic in character.

Next to taxes on consumption levied on the dealer come those levied on the transporter—namely, import, export, and transit duties. This form of indirect taxation is the favorite form of national and Federal revenue, owing to the ease of collection and owing to the industrial advantages which are claimed for protective custom duties in fostering domestic industries. In fact, customs duties are looked upon in most cases not as purely questions of fiscal legislation, in which case we could truly speak of a "tariff for revenue only," but as questions of industrial legislation. (See TARIFF.) The amounts raised in this way by the nations of the world are considerable, as is seen from the following table, which gives the percentage of the total ordinary revenue of the various nations derived from taxing imports and exports (1890–91):

	Per cent.		Per cent.
Peru	73	Portugal	42
Mexico	68	Sweden	39
Argentine Republic	65	Germany	31
United States	56	Great Britain	27
Brazil	55	Italy	15
Norway	46	Russia	12
Switzerland	43	France	10

Import duties, however, are not levied at a nation's frontier alone. In many countries, notably in France, such taxes on consumption are levied at the gates of the cities. The *octroi* of French towns originated in the Middle Ages, and still taxes the importation into the towns of liquors, wines, and food products, fuel, and building material. In this way $27,000,000, more than half the ordinary city revenue of Paris, were raised in 1887. The constitutional law and economic development of the U. S. prevent the introduction of State or municipal customs duties.

Finally, taxes on consumption may be levied on the producer, with the intention of having him reimburse himself at the consumer's expense. Such a tax is based upon some external criterion, such as the amount of invested capital, horse-power, size and character of machinery, of boilers, size of factory or storehouse, or on some similar feature. In the U. S. the so-called *internal revenue system* involves such taxes on consumption levied on the producer. In extent it has been the most variable form of Government revenue. Beginning in 1789, it yielded but a small sum annually before the war of 1812, when the amount rose to above $5,000,000. During the following years of peace the internal revenue fell off, and disappeared in 1848. During the civil war (1861–65), the internal revenue system was again introduced, and has yielded large sums ever since. During and immediately after the war it amounted to a general tax on industry, the tax being directed at almost every kind of industry. When the necessity for an enormous Federal revenue declined, specific lines of industry were successively released from the tax, so that nowadays the production of spirits, fermented liquors, and tobacco are practically the only lines of industry affected. This is clear from the following table, which gives the highest amount paid by the following industries in any one of the years since 1862 (in millions of dollars):

Banks	4·9	(1865)
General industry	236	(1866)
Adhesive stamps	16	(1872)
Tobacco	47	(1882)
Spirits	83	(1891)
Fermented liquors	28	(1891)

The receipts of the Federal Government under the internal revenue system during the fiscal year 1891 were as follows (in millions of dollars):

Tax on spirits	83·3
Fermented liquors	28·5
Tobacco	32·7
Oleomargarine	1
Total	146

The taxation of the consumption of liquor, beer, and tobacco is a favorite financial expedient of modern nations; in fact, no tax is more easily collected and meets with less opposition, notwithstanding the attempts to evade the law, as in the case of illicit distilling. In general, the smokers and drinkers in the world bear the heavy taxation to which they are subjected without murmuring. In Great Britain $201,000,000, almost half the national revenue, are derived from taxing the importation ($69,000,000) and sale ($132,000,000) of tobacco and intoxicants.

Taxes on Revenue.—A tax upon the revenue from *land* is the earliest and most widespread form of taxation of revenue, because land is visible, tangible, and immovable, three qualities which make it pre-eminently serviceable as an object of taxation. Its value can readily be determined, and payment can be enforced by attachment. The earliest form in which a land tax appears is that of a tax of a specific sum on each acre of arable land or other unit of area. This method is of course grossly unfair, in that it does not properly distinguish between lands which differ in situation or productivity, and has been generally outgrown. A later method divides land into various classes according to productivity, and taxes each class uniformly per acre. A land tax of this kind was in vogue in the Southern colonies of Great Britain in America before the Revolution, but is extremely unfair. The next step forward was taken in taxing land according to its *gross* product. This is the principle involved in all tithes, which are still collected in less civilized countries. It is an extremely simple form of taxation, and amounts to taking from the agriculturist a certain fraction of all he raises. The serious objection to it is that it discriminates against enterprising farmers and in favor of those who dispense as much as possible with the use of capital, for by the law of diminishing returns the farmers can not increase their gross product in proportion to their increased application of labor and capital. The land tax reaches its fullest development when it is directed at the *net* product of land. This system is very general in European countries, where such land taxes furnish a large part of the revenue from taxation. In fixing the amount of net product subject to taxation two methods are adopted. In France the annual net product of each acre was established by an official survey, called a *cadastre*, made at heavy expense during the years 1807–50. Similarly strict surveys have been made in Prussia, Austria, Italy, Baden, and in other countries. The rigid assessments based on these surveys, which are completed at great cost, must necessarily become antiquated and inaccurate, owing to changes in the mode of production or in the kind of product. The mechanism of the cadastral system, however, when once established, is very simple and has the advantage of raising a fixed sum annually. The British tax on revenue from land and farmers' profits is more flexible, being based not on a permanent but on an annual assessment made by the landed gentry, who serve without pay.

Just as the revenue from land is taxed, so the revenue from capital invested otherwise is taxed. Such a system is carried out in France and Austria. Aside from the land tax, a tax on revenue does not often distinguish the various sources of revenue, but is aimed at revenue in general. The earliest and simplest form of a general tax on revenue is the *poll* or *capitation tax*, which demands the same sum from every taxpayer. Poll taxes were a favorite means of raising public revenue during the colonial period in North America, and have been retained to this day in most of the States of the Union, New York and Pennsylvania being the leading exceptions. Besides State poll taxes, the same are raised in the lesser political units, generally for educational purposes, the theory being that each taxpayer has an equal interest in the public-school system, and therefore should contribute the same sum to that object. Poll taxes must necessarily weigh heavily on people of small means. In fact poll taxes can not be consistently carried out, for the enforcement of payment by people of small means is impossible or politically inexpedient. Similarly to the steps in the development of the land tax, the poll tax is improved upon by the introduction of the *class tax*. This tax divides the population into classes, based on social position or some other criterion, and demands the same sum from those in the same class. Such a class tax has existed in Prussia since 1821. It divides the taxpayers into various classes and sub-classes, according to their presumable income, each sub-class being taxed a fixed amount per head. If the number of classes in the class tax is indefinitely increased, the tax approaches an *income tax proper*, in which the amount of the individual's income is determined by official or self assessment, and the rate of taxation, in percentage of that income, is fixed by law. By multiplying the amount of income, thus determined, by the tax rate, the amount of the tax is obtained. A proportional income tax is one in which the tax rate is the same for incomes of every size; a progressive income tax is one in which the tax rate increases as the income increases, relatively more is taken from large than from small incomes.

The leading modern income tax is that of the United Kingdom. It was adopted in 1798, distinctly as a war measure. It was repealed in 1816, when peace was restored, but was again introduced in 1842, and was renewed every few years. It was long unpopular, but it finally became a recognized part of British taxation. Its peculiar characteristics are its system of schedules, and its variable tax rate and exemption limit. By dividing taxable income according to its sources under five schedules, the assessment and collection of the British income tax is very much facilitated. Schedule A is directed at the income derived from the rent of land and houses—a form of land tax, as is shown above, which affects the landlord class. Schedule B is directed at the profits of land-renters, the farming class. Schedule C is directed at income derived from investment in Government bonds; in the case of domestic Government bonds the interest is retained by the treasury, and in the case of foreign government bonds the tax is collected from the authorized disbursing agents. Schedule D affects the largest class of incomes—namely, those from professions, trades, and from other sources, such as investments at home or abroad other than in Government bonds. Schedule E is directed at incomes from government salaries and pensions, the tax being withheld by the Government. In the case of Schedules A, B, and D the assessments are made by a board of assessors. The amount raised by the income tax is made to vary according to the needs of the Government by raising or lowering the rate of taxation, or by fixing the amount of income exempt from taxation at a low or a high figure. The other nations of Europe have with few exceptions followed the example of Great Britain, and have adopted income taxes as a regular feature of their systems of revenue. Unsuccessful attempts have frequently been made to introduce a French income tax; but the democratic principle, that an income tax is inquisitorial and interferes with the rights of a free people, has always prevailed. In the U. S. weak attempts have at times been made by the States to introduce income taxes, but without much success. In the Federal finances of the U. S. an income tax of large proportions was introduced as a war measure in 1862, and remained in existence ten years. During the civil war the rates were frequently raised and the exemption minimum lowered as a means of increasing the revenue. After the war, when the Federal public expenditure had fallen off, the opposite course was pursued; incomes of smaller size were freed from taxation and the rates were lowered. Finally, owing largely to the unpopularity of the system, the income tax went out of existence in 1872, but arrearages were collected as late as 1877. In all $347,000,000 were raised under this income tax, of which $73,000,000, the largest amount raised in any one year, were raised in 1866. But the amount raised in this way varied greatly: thus in 1867 it was but $27,000,000. By the first law incomes of $600 and less were exempted from taxation; on incomes between that sum and $5,000 5 per cent. was levied; on incomes between $5,000 and $10,000, 7 per cent.; and on incomes over $10,000, 10 per cent. Whatever was paid for rent or repairs was deducted. By subsequent laws the limit of exemption was raised from $600 to $1,000, and later to $2,000.

Taxes on Possession.—These tax a man not according to what he spends or earns, but according to what he owns. The leading feature of the State and local financial systems of the U. S. is the best and almost only example of a tax on possession in existence. The principle at the foundation of this property tax has always been the same since its origin in colonial days—namely, that every one should be taxed in proportion to the amount of property in his possession. Almost all the property of the colonists consisted of real estate, the valuation and taxation of which were easy matters. The property tax was in fact a real property tax, the most practical and equitable form of taxation under the economic conditions then prevailing. With the growth of the country, and the development of trade and industry, the relative importance of personal property grew. While real property can be seen and examined, and its value determined, personal property is in most cases mobile and often to all intents and purposes invisible, and can easily escape the notice of the tax official. Every attempt to remedy this difficulty, by making the oath of office of the assessors more stringent, or by direct interference of the State governments, has failed. Three points must be emphasized in the development of the property tax as imposed in the U. S.—namely, the change from a tax on *persons* to a tax on *things*, its connection with the *right of suffrage*, and the influence of the *Federal Government* on its development. In the colonial period the property tax was distinctly a tax on persons, and as property was in those days generally distributed, and the class of paupers was small, the tax reached the great mass of inhabitants. In the course of time the tax has become as distinctly a tax on things, directed not at persons, but at their property, more particularly at their real property. From once being a general tax on all property owners, it is approaching in character a fixed charge on real estate. Hand in hand with this change has gone a change in the relation between the taxpayer and the voter. During the colonial period the body of property taxpayers was practically coextensive with the inhabitants who enjoyed full rights of citizenship. This relation was recognized and maintained for two centuries. Property qualifications to the right of suffrage were the rule until well into the nineteenth century, and were then gradually done away with under the pressure of the democratic movement of the century. The only exceptions are the cases in which the law provides that the payment of a poll tax shall be a prerequisite to voting. In practice these petty restrictions amount to nothing. Property taxpayers are no longer coextensive with the voters; the voter often stands opposed to the taxpayer; the former lays the tax, the latter pays it. This conflict of interests comes up for instance in the matter of municipal finance. It makes any change in taxation difficult, for the voter, with whom the initiative lies, is not anxious for a change. Previous to 1789 each commonwealth was at liberty to derive a revenue from customs duties. This source of revenue was cut off by the Federal Constitution. Aside from this direct constitutional provision, the Federal and State and local taxes were left to compete with each other. The Federal Government secured the two most copious sources of revenue—customs duties and internal revenue—and compelled the States and lesser political units to extend more and more their general property tax; so that now opposite forms of taxation are represented on the one hand by the Federal taxation of consumption, and on the other by State and local taxation of possession. Moreover, the interpretation of the Federal Constitution by the courts interferes greatly with the consistent carrying out of the property-tax system. Under the clause of the Constitution which gives Congress sole power to regulate commerce between the States, or between a State and a foreign nation, large classes of personal property can not be taxed by the States or locally, because such goods are being transported from State to State or to some foreign country, or because they are still in their original packages. The taxation of corporations doing business in more than one State, such as railways, has been made difficult by a similar line of decisions.

The essential features of the property tax in the U. S. are as follows: All property is avowedly assessed at its market value, and is taxed at some uniform rate. Real estate includes all immovable, and personal estate all other property. Certain classes of property are exempt from taxation: 1. State and Federal Government property, the latter including all public buildings, forts, navy-yards, and Government land, but more particularly all U. S. bonds and notes. 2. The property of religious, charitable, and educational institutions, which when used for those purposes is generally exempt from taxation, on the theory that such institutions serve a public purpose and should therefore not bear the public burdens. 3. A minimum of property, which the law allows each taxpayer to withhold from taxation; this generally includes household furniture, tools, and growing crops, up to a certain amount. The assessment or valuation of taxable property is made by the assessors—officials elected by the people and generally in the smallest political units. The individual assessment lists of a township form the township assessment list; the lists of the various townships form the county list, which is controlled and corrected by a county board of review; the lists of all the counties form the State list, controlled by a State board of review. The amount to be raised for the State is divided among the counties in proportion to their corrected lists; each county adds its share of the State tax to its own county tax, and divides the amount among the townships in proportion to their corrected lists; the towns finally add to their share of county and State taxes their town taxes, and divide the amount among the taxpayers in proportion to their individual assessments.

The inherent difficulty in the property tax in the U. S. has reference to the uniform assessment of *all* property. *Real estate* can easily be found, and can be assessed, if necessary, at its true market value. But *personal property* generally escapes the assessors' notice, or is exempt because of constitutional objections. Uniform taxation of real estate is difficult but possible; uniform taxation of personal property is impossible. The difficulty of taxing personal property is particularly evident in the matter of *corporation taxation*. Corporations were at first included under the general property-tax system as persons, as individual owners of property. Corporate real estate is generally taxed wherever situated, and corporate personal estate is taxed in name at least in the taxing district where the principal office of the corporation lay. But the attempt to apply the principles of the property tax to the taxation of corporations has signally failed. Little by little possession is being discarded and product or earnings accepted as a criterion on which to base the taxation of corporations. This movement started at the beginning of the nineteenth century. First the banks, then the insurance, telegraph, telephone, and express companies were divorced from the property tax system and were taxed separately, if not on their property, then on their earning power. This movement is best illustrated in the case of railway corporations in the U. S. The simplest tax upon a railway is based on a valuation of its *property* by a local or a State board of assessors. Another method of railway taxation is based upon an assessment of the railway's *capital*, either at its par or at its market value, or the assessment may be based upon the market or par value of the aggregate *capital and bonded indebtedness*. This last method of corporate taxation is not on a line with the principles of the general property tax, for under that system of taxation the bonded indebtedness would have to be deducted from the aggregate amount of property to obtain the true value of taxable property. In taxing a railway on the amount of business transacted, a complete departure is made from the principles of the property tax. A tax on *gross earnings* is practically impossible, because when directed at railways, whose traffic is interstate—and the majority of railways come under this head—it has been held to be unconstitutional, in that it infringes upon the rights of the Federal Congress to regulate commerce between the States. A similar tax on the *net earnings* of railways may eventually meet the same fate. Finally, railways may be reached by a *franchise tax*. The franchise tax, though not satisfactorily defined in law, amounts to a tax on the excess of value of the corporate property as a whole above the aggregate value of the individual pieces. A variety of means are employed in the different States to determine this excess value. The possibility of developing franchise taxation lies in the fact that the law is likely to make a distinction between a franchise tax and a property tax; that while most State constitutions require all taxes on property to be uniform, this provision would not apply to franchise taxes, and would allow a freer development of that form of taxation than is now possible.

The desire to tax corporations by the State governments, independently of the local governments, and the difficulty of taxing personal property, owing to the facility with which it may be concealed or its value may be misrepresented, or owing to its exemption from taxation by constitutional provisions, has led in the U. S. to the introduction of State corporation taxes, which directly reach the corporations, without the intervention of the lesser political units. Pennsylvania took the lead in this development and now raises more than half her State revenue, $5,500,000 out of $10,700,000, by State corporation taxes; New York State has followed suit, and now raises one-eighth of her revenue in that way. Other States are falling into line. Moreover, collateral and direct-inheritance taxes are being adopted by the States. The introduction of such inheritance taxes, which demand a certain percentage of all moneys inherited, is the best illustration of the successful attempt to develop the tax system along other than the traditional lines. The tendency is strong to find other sources of revenue than the property tax for the State governments, and to leave the latter tax to the subordinate political units, which have greater facilities for securing correct returns of the amount of taxable property. Pennsylvania, for instance, derives only two-fifths of her State revenue from the property tax. This tendency is in keeping with the more general one of limiting the Federal Government to the taxation of consumption, by customs duties and the internal-revenue system, the State governments to the taxation of corporations, and the local and municipal governments to the taxation of property, more particularly of real property. This is illustrated in the following tables:

U. S. Federal Revenue, 1890–91.

From customs duties	$219,522,205
Internal revenue	145,686,249
Profits from coinage	6,714,344
Fees and fines	3,985,904
Public lands	2,518,064
National banks	1,236,043
Pacific railways	823,904
Sale of Government property	259,376
Miscellaneous receipts	6,513,338
Total ordinary revenue	$387,259,427

The great importance of the taxation of consumption in the Federal finances is seen from the fact that nine-tenths of the revenue is derived from that source. The profits from coinage—the so-called seigniorage—arise from the difference between the market value and the face value of the metals coined, the Government purchasing silver, copper, and nickel and turning them into coins, worth more on their face than the metal they contain. Strictly speaking, the public lands should not figure as netting the Government anything (see above). The tax on national banks is a tax of 1 per cent. on their circulation of bank-notes.

Pennsylvania State Revenue, 1890–91.

From corporation taxes	$5,564,072
Licenses	2,029,841
Collateral inheritance tax	1,227,302
Property tax	1,904,987
Miscellaneous receipts	66,444
Total ordinary revenue	$10,792,646

New York State Revenue, 1890–91.

From property tax	$8,031,401
Corporation taxes	1,535,875
Collateral inheritance tax	890,268
Interest on investments	761,811
Fees and fines	306,836
U. S. Government	109,903
Miscellaneous receipts	55,948
Total ordinary revenue	$11,692,042

The large amount Pennsylvania raises by its taxation of corporations, half of its ordinary revenue, and the large sum New York derives from its invested funds are noticeable.

New York City Revenue, 1891.

From property tax	$33,229,290
Water rent (gross)	3,272,080
Sale and rent of city property	2,837,254
Local assessments	2,715,851
Liquor licenses	1,459,830
Other licenses	675,857
State of New York	724,533
Interest on investments	475,303
Fees and fines	258,990
Miscellaneous receipts	133,104
Total ordinary revenue	$45,782,092

Almost three-quarters of the municipal revenue of New York is derived from taxing property. The rent and sale of city property net an unusually large sum, because of the large income from the rent of its docks. Liquor licenses bring in a large amount, as they do in most cities or States. While the gross revenue from the sale of Croton water seems large, the net revenue probably amounts to little, owing to the charge for maintenance and for interest on the bonds issued to provide a supply of water, which items must be covered by the gross water revenue. This is also true in most other cities of the U. S. In a few, however, the revenue from the city water-works is sufficient to cover running expenses and the fixed charges for interest on the debt incurred on account of the water-supply.

It was said above that the various spheres of Government expenditure in the U. S. do not find their counterpart in other countries. The same holds good, to an even greater degree, of spheres of Government revenue, especially as regards the character of the various sources of revenue. The national revenue of Great Britain during the fiscal year 1890–91 was as follows (in millions of dollars):

From excise duties	120
Customs duties	94
Stamp taxes	65
Income tax	64
Post-office and telegraph (net)	59
House and land tax	12
Fees	4
Government domains	2·5
Profits from coinage	2
Dividends from Suez Canal shares	1
Bank of England	0·8
Profits from savings-banks	0·3
Interest on advances	0·2
Miscellaneous receipts	2
Total ordinary revenue	427

It is seen from these figures that about half of the British revenue is derived from excise and import taxes; namely, from taxing the consumption of spirits, wine, beer, tobacco, and tea. These, with the exception of wine, are articles of general consumption; hence these taxes affect practically every one, but not uniformly, for the well-to-do spend relatively less on these articles of consumption than the poor do. The large amounts derived from the income tax and from the Government post-office and telegraph departments are noticeable—the figure $59,000,000 indicating the surplus of gross earnings over running expenses.

A somewhat different revenue system is presented by Prussia:

Prussian Ordinary Revenue, 1891–92 (in millions of dollars).

From Government railways (net)	90·6
Government mines, etc. (net)	5
Government domains (net)	11
Direct and indirect taxes	48
Lottery	2
Miscellaneous receipts	17
Total ordinary revenue	173·6

Almost two-thirds of the Prussian revenue are derived from Government property—the railways, domains, mines, etc.—and only about 28 per cent. from taxation. Customs duties are wanting, as they are in the revenue of the States of our Federal Union, and are reserved for the German empire. The leading Prussian taxes are an income tax, a house and land tax, and a license tax on industry. The fact that Prussia nets $2,000,000 from its Government lottery is to be noted; similar lotteries are maintained by many other European governments.

A still more striking difference is found between municipal revenue and the corresponding revenue of American cities.

Paris City Revenue, 1887 (in millions of dollars).

From octroi duty	27
Taxes	7
City property	6
Gas and water works	6
National Government	2
Miscellaneous receipts	3
Total ordinary revenue	51

The chief item of city revenue, it is seen, is the octroi duty. The city property, the markets, sewers, cemeteries, and the gas and water works bring in one-quarter of the entire revenue. The municipal taxes are based on and are in addition to the national taxes, much as the State taxes in the U. S. are based on and added to the local taxes on property.

Berlin City Revenue, 1888–89 (in millions of dollars).

From house and house-rent tax	4
Income tax	3·5
Gas and water works	2
City property	2
Miscellaneous receipts	6
Total ordinary revenue	17·5

The municipal tax on houses and on house rent is a tax on consumption and is directed at the householders; the income tax is based on the Prussian income tax, a similar arrangement to the one in Paris.

A comparison of the above tables suggests the great difference in the revenue systems of various countries; in some the governments derive large incomes from their property, or from business enterprises, and depend little on taxation; in other countries the opposite holds true. In the combinations of taxes, the tax systems, there is the same variety; some governments leaning to the taxation of consumption, like most federal and national governments, some to the taxation of revenue, and others, like the State and local governments of the U. S., to the taxation of possession. In examining the variety of tax forms adopted by different countries, the question naturally suggests itself, what are the proper principles of taxation? that is, in what proportion should each taxpayer contribute to the support of the government? Some hold that he should be taxed in proportion to what he spends; others, in proportion to what he earns; and still others, in proportion to what he owns. This leads to the question of an individual's ability to pay taxes. See TAXATION.

Public Loans.—The last class of public revenues are the public loans, the leading item of extraordinary public revenue. (See DEBT, PUBLIC.) When other sources of income fail, a government issues a loan, it borrows from the lending public. The first distinction to be made is that between *forced* and *voluntary* loans. In the case of forced loans, the government compels the public to accept its promises to pay in return for some article desired by it. The leading example of forced loans in modern times is the issue of legal tender paper money, which the creditors of the government are obliged to accept at their face value. In the case of voluntary loans the government enters the money market with its bonds, that is, with its promises to pay, and offers to sell them to the lending public. *Floating* and *permanent* loans or debts are distinguished. A floating or unfunded debt is due to unsettled accounts, outstanding warrants or notes issued in anticipation of revenue, which represent a temporary indebtedness. When these have been replaced by a regular issue of interest-bearing bonds, the debt becomes permanent, or funded. A large floating debt, in the case of governments, as well as of individuals, is usually a sign of financial weakness. Loans are classed as *productive* or *unproductive*, according to the productive or unproductive investment of the proceeds. Thus the public debt of Prussia was largely incurred for the purchase of railways, which investment has proved remunerative, the interest charge being more than covered by the net receipts from those railways. On the other hand, the public debts of the U. S. and of Great Britain are unproductive, inasmuch as the proceeds of the loans were wasted in wars—that is, they were unproductively invested. Whether loans are *redeemable* or *irredeemable* depends upon the ability of the government's creditors to claim repayment of the principal of the debt. In the U. S. Government loans are quite generally redeemable, the principal becomes payable after a certain number of years; in Europe there is a strong tendency toward irredeemable loans, the governments merely promise to the holders of their bonds the annual payment of a fixed sum in perpetuity, so-called "permanent annuities," however, reserving to themselves the right of repaying the principal of the loan when they see fit. Finally a public loan is said to be *secured* when some specific government property or revenue is pledged to the payment of the interest or principal. A financially weak government finds it necessary to secure its loans with its customs revenue, or with the revenue from some specific tax, established for that purpose; otherwise the lending public has no confidence in its promises. A financially strong government, however, need not secure its loans in this way; the good faith of the government, its credit, is sufficient, in the eyes of the lenders, without any such pledge. A sovereign power, in borrowing, enters into a contract relation with its creditors. But from its sovereignty it follows that it acknowledges no power above it, which can interpret and enforce that contract. Thus a national government can borrow, but it can also repudiate its debt with impunity—that is, it can break its contract and become bankrupt. Such national bankruptcies can readily occur in the case of financially weak governments, and may lead to wars. In the case of individual States of the U. S. repudiation and arbitrary reduction of interest have been of frequent occurrence; the delinquent States are protected in their quasi-sovereign capacity by the eleventh amendment to the Federal Constitution, adopted in 1798, which prevents their creditors from enforcing in the Federal courts the terms of the contract on which State loans are based.

The outstanding indebtedness of a government is indicated by the amount of principal of the debt, or of the annual interest charge. By the *conversion* of a public debt is meant a change in the amount of principal or of the annual interest charge of the debt, offered to its creditors by the government, and voluntarily accepted by them. A conversion generally amounts to a reduction of the interest charge. It appears in its simplest form when the government offers to the holders of its bonds, the principal of which has fallen due, the alternative of repayment in cash, or in new bonds bearing a lower interest. If the government's credit has improved—that is, if it can borrow at lower rates than formerly, a condition necessary to a successful conversion—the creditors will rather receive the new bonds than receive cash in payment for the old ones, and in this way the old loan, which may have borne a high rate, is converted or changed into a new one bearing a lower rate of interest.

The *redemption* or payment of a public loan is facilitated by providing that a part of the outstanding bonds shall be redeemed annually. Moreover, a so-called *sinking fund* is often introduced, with which the principal of a public debt is redeemed. A certain fraction of the debt is annually invested in some form of security, generally in the outstanding bonds themselves; the interest from these annual investments, together with the further investments from year to year, constitute a sinking fund, which it is planned shall accumulate to an amount sufficient to redeem the principal of the debt when it falls due.

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J. C. SCHWAB.

Fin-back: a name given to the whales of the sub-family *Balænopterinæ* on account of their prominent dorsal fin, an appendage which in many whales is comparatively small, or rudimentary. They are comparatively slender, with a small, pointed head, the throat is longitudinally wrinkled, and the baleen is short and coarse. The fin-backs include some of the largest of animals, among them *Balænoptera sibbaldius*, which attains a length of 80 feet. On account of the great strength and power of endurance of these whales, coupled with their small yield of oil and the shortness of the baleen, they are but little sought after. In some localities, however, they are the object of inshore fisheries and the use of steamers, gun-harpoons, and bomb-lances makes their capture practicable. F. A. LUCAS.

Finch [M. Eng. *finch* < O. Eng. *finc*: O. H. Germ. *fincho* > Mod. Germ. *Fink* < Teuton. **finki-*: Celtic *pinc-*, whence Fr. *pinçon*: Ital. *pincione*, finch]: any one of various birds of the family *Fringillidæ*, but more particularly those of the sub-family *Fringillinæ*. The American finches are mostly of the genera *Carpodacus*, *Chrysomitris*, *Pipilo*, *Cyanospiza*, *Poocætes*, *Chondestes*, and *Zonotrichia*. They feed on seeds as well as insects, are generally bright, active birds, and some are good songsters. See FRINGILLIDÆ, GOLDFINCH, BULLFINCH, CHAFFINCH, etc.

Finch, DANIEL and HENEAGE: See NOTTINGHAM.

Finch, FRANCIS MILES: jurist and poet; b. at Ithaca, N. Y., June 9, 1827. He graduated at Yale College in 1849, practiced law at Ithaca, and in 1881 became a member of the New York State court of appeals. In 1892 he became dean of the law school, Cornell University. Among his poems are *The Blue and the Gray*, first published in *The Atlantic Monthly* in 1867, and *Nathan Hale*.

Finck, HENRY THEOPHILUS: See the Appendix.

Finding: the act of one who finds. In law this term has the same meaning as in popular language. The finder of lost property upon land who takes it into his possession becomes invested with a special property therein, which is superior to the claims of all persons except that of the true owner. He is under no legal obligation to take into his custody any articles he may thus discover, but if he does, certain important rights and obligations immediately attach to his possession. His primary duty is to preserve the property intact, and in as excellent condition as its nature and state at the time of finding will permit, in anticipation of the owner's appearing to reassert his title. A finder thus becomes a kind of bailee, and, like other bailees, he may defend his possession and interest by bringing action against any third person who injures the property, or asserts dominion over it, or interferes with his immediate ownership. If the absolute owner ever appears, restoration must be made to him, and the finder will be entitled to no reward if none had been previously offered, and can only claim to be remunerated for the actual and necessary expenses incurred in the proper care of the goods. But if a specific reward had been promised, of which the finder had knowledge, he would be authorized in demanding it, and would have a lien upon the property until such charges were satisfied. If at the time of making the discovery the finder knew, or had means of readily ascertaining to whom the property belonged, it would be his duty to seek out the owner and return whatever he had thus acquired; and if he failed to do this his retention of the goods would be a fraudulent appropriation of them which would constitute larceny. But in cases where knowledge of ownership could not be acquired no larceny could be committed. Retaining the chattels would then not be wrongful, but reasonable and obligatory. If the former owner can never be discovered or never asserts any claim to the property, it vests absolutely in the finder. The place where the finding occurred is immaterial as regards his rights. If an article which was lost in a store was picked up by any stranger, he would have the first claim to it, and if the owner never reappeared might enforce his title even against the storekeeper. This would not be the case, however, if the article was only left by accident, for it would then be regarded as confided to the keeping of the proprietor of the store, who might demand it from any one by whom it was discovered.

The finder of a chose in action, as a check or lottery-ticket, can not enforce payment of it if the party liable under it has notice that the applicant is not the real owner. If in such a case payment was made, the proper owner would not be debarred from a subsequent recovery. If, however, the finder transferred the instrument for value to a *bona fide* holder who was ignorant of his defective title, it would, if negotiable, be good in the latter's hands, according to general principles governing commercial paper.

At common law there were special rules concerning the finding of *estrays*—i. e. of cattle whose owner is unknown—but this matter is now generally provided for by statute. For the rules applying to TREASURE TROVE, see the article on that subject; in regard to goods found at sea, see the article SALVAGE.

Findlay: city and railway center; capital of Hancock co., O. (for location of county, see map of Ohio, ref. 2–D); 90 miles N. W. of Columbus. It has foundries, machine-shops, edge-tool works, flouring-mills, carriage-factories, spoke-factory, stave-factory, rake and handle factory, barrel-works, clay-pot works, an extensive pottery, brick, and tile works, and a large pressed-brick factory. It is the center of a natural gas-field, and since 1885 has become an important manufacturing center for glass-works, rolling-mills, nail-factories, etc. Pop. (1880) 4,633; (1890) 18,553; (1900) 17,613.

EDITOR OF "JEFFERSONIAN."

Fine [M. Eng. *fin*, end, fine, from O. Fr. *fin* < Low Lat. *finis*, end, settlement, fine (Lat. *finis*, end)]: a pecuniary mulct imposed by a court upon a criminal offender as a means of punishment. The precise amount of the fine is commonly left to the discretion of the court, though a maximum and minimum sum appropriate to each particular offense is, in general, designated by statute, and the exercise of judicial discretion must be confined within these limits. There is a provision in the U. S. Constitution that "excessive fines shall not be imposed."

Fine, feen, ORONCE, generally called **Orontius Finæus**: mathematician; b. in Briançon, in the department of Hautes-Alpes, France, in 1494. He received his first instruction from his father, who was a physician of great reputation. Afterward he studied philosophy and the sciences in the University of Paris, but finally he determined to devote himself wholly to the study of mathematics. Very few mathematical works were printed at that time, and the manuscripts were much scattered and not easily accessible. Furthermore, during the preceding centuries, mathematical science had been very much mixed up with cabbalistic elements, and it is Fine's great merit that by his numerous publications he not only made the study easier, but restored its scientific basis. Of his numerous works hardly more than half have been printed; the principal are *Quadrans astrolabicus* (1527–34); *Æquatorium planetarum* (1548); *La Théorique des cieux*, etc. D. in Paris, Oct. 6, 1555.

Fine Arts: the arts which address the sense of beauty or of sublimity or of grace, and are intended to give an exalted kind of pleasure. The fine arts are those which are calculated to serve not the daily needs of men in the way of food and other necessities and comforts, but their need of subjects of admiration and love, or, in a lower sphere, their need of that which shall charm the eye or the ear. The use of colors in simple combinations, as in stripes and zigzags, is not very lofty art, a popular tune is not very refined music, and from such art as these there results a pleasure which is high only in comparison with the purely sensual pleasures. But a great painting or a great musical composition may give pleasure of a very high and enduring kind, and will give the highest pleasure to the loftiest and most cultivated intelligence.

Of all the fine arts music is the purest, because the sources of pleasure in it are purely artistic. It tells no story, represents no fact, relates no incident, but merely excites and gratifies the sense of beauty by means of a combination of sequences of sounds. Painting, when especially directed toward beauty of form and color, and sculpture, when especially directed toward beauty of form, come next to music in dignity; but both these arts have more or less of a purely intellectual appeal to memory or to association in all or nearly all of their productions. Thus a painting of landscape is pure fine art so far as it is in itself a beautiful thing and a majestic or dainty composition, so far as it appeals to the sense of beauty and the kindred power of appreciation, and so far as it reveals natural beauty or grandeur in a way that verbal description can not do; but in so far as it shows some scene interesting for private or public associations it is not pure fine art, but rather a descriptive art partaking of the nature of history. But neither painting nor sculpture is capable of being separated from the suggestion of natural objects. This is because our human powers are not sufficient to enable us to make fine designs in color or form except by taking the suggestions of external nature. The most perfect combinations of line, of surface, of mass, of dark and light, or of color come as hints from the external world. The plastic and graphic arts, therefore, are less absolutely artistic than music, more complex, less capable, perhaps, of exciting great enthusiasm.

One art which appeals to the eye is almost absolutely pure fine art—namely, gardening in its higher branches. What is called LANDSCAPE GARDENING (*q. v.*), if including all laying out of grounds, large and small, with a single reference to beauty and grandeur of the resulting scenes, must be considered as ranking high among the fine arts. The mere study of the swells and sweeps of the ground and their accentuation and modification is a noble art akin to sculpture. Another art, seldom named as a fine art at all, must yet be classed as such in its purposes and capabilities at least—the making of fireworks. It seems a little strange that this and the art of illumination should not have been considered together as the single art of using fire decoratively. There are reasons why no very high development is possible to this art, but it is assuredly one of the fine arts.

Dancing also, which is not generally classed among the fine arts, has yet a claim to be considered as capable of becoming a very pure fine art. If looked at as a kind of moving sculpture, it is seen to have large capabilities. A sequence of stately or graceful attitudes of the body may certainly be a work of fine art. It may have been at different times in antiquity a statelier and more beautiful art than we know it, and Eastern dancing to-day points to such a probability. It has also been proposed to group and combine odors so as to produce a fine art appealing to the sense of smell, but this has never been done.

With these definitions in mind we are now able to qualify architecture, which is generally counted among those fine arts which appeal to the sense of sight. When a designer is composing a building so that its exterior shall be a beautiful and imposing mass or group of masses, he is doing fine art work. When he is arranging the statues in the porch and the floral sculpture in the canopies and molding, so as to bring these and the main lines of the porch itself into one harmonious whole, he is doing fine art work. When he is planning a hall and staircase (a most difficult subject) so that all the many points of view shall afford only graceful or imposing groups of line, and investing the whole with agreeable color, he is doing fine art work. So, in a smaller way, when he is arranging the colors for the wall and ceiling of a room, and deciding whether there shall be a dado at bottom and a frieze at top of the wall or not, and how the ceiling shall be paneled, he is doing fine art work so long as he is thinking only of the result as a piece of design as being beautiful, or at least comely and fitting. Fine art so used to beautify that which exists primarily for utilitarian purposes is called DECORATIVE ART (*q. v.*). Ordinarily, however, a number of considerations of material, utility, etc., come in and prevent the work of the builder from being fine art in any high sense, or even from being fine art at all. Thus it makes no difference whether there is plenty of money or not, the designer may make his design a good piece of fine art in spite of low cost; but if he has to provide very large windows in a certain part of the walls and a doorway and porch in another place, or to use a perfectly flat roof, this necessity may wholly destroy the artistic character of his work. Indeed there are many requirements of modern life which seem to tell directly against beauty of design. For these reasons the fine art in most buildings is of an inferior kind, and is not very impressive, consisting only in slightly pleasing or not displeasing proportions and color which is not disagreeable.

The fine arts are commonly said to be painting, sculpture, and architecture, excluding music, poetry, eloquence, and the dance. But if we in this way use the term "fine art" or "the fine arts" for the arts of color and form alone, there are really but two of them, namely, the art of molding and carving form, and the art of representing solids on a surface by means of form, light, and shade and color. Architecture is not a separate and distinct fine art at all, but a means of making buildings beautiful by adding to them the appeal to the sense of beauty by means of color and of form. The process of making a silver cup or a sword or a rug or a book-cover beautiful is exactly the same as that of making a building beautiful; and the art of the bookbinder, the weaver, etc., is a fine art to exactly the same extent that architecture is. It is therefore a mistake to speak of architecture as a separate fine art; it is indeed "the highest of the industrial arts," as is stated under ARCHITECTURE, and it may be called the most important manifestation of decorative art.

The act of creating a work of fine art is the carrying out the conception which arises in the mind. A painter has an oblong canvas or panel or piece of paper, and as he sits before a natural landscape, or as he looks at a sitter who has come to him for a portrait, or as he is struck by the beauty or the possible beauty of a group of children engaged in such or such occupation, he sees more or less clearly the future picture on the blank rectangle before him. He composes a group or a scene. Of course he may restrain himself and note down only what he sees, or only part of what he sees, but this is not producing a work of art in the high sense; it is only providing himself with material; it is *study*, like the study of any mental workman. It is true that an excellent work of fine art may be very like nature, but that is only when the conception of the artist does not take on a character further away from the natural facts; the resemblance to the natural fact is not necessarily a merit in the work of art; but because a tree is a more beautiful thing, with its grace and variety, its mystery of color, the visible signs of its growth and life upon it, than anything man's mind can create out of nothing, therefore it is generally the greatest artist who knows the most about his tree and is able to give the most essential facts about it, and does give them while trying only to express his artistic thought.

The fine arts which appeal to sight are often called the *graphic and plastic arts*; and these terms are sufficient for sculpture and for painting and its subsidiary arts, but do not seem to cover gardening nor architecture and the other decorative arts. They may also be characterized as the *arts of representation and expression* and the *arts of decoration*; for it is the chief business of sculpture, painting, drawing, etc., to give pleasure at once by revealing truths of external nature and of sentiment, and by the absolute beauty of the resulting work, while art in pottery, metals, architecture, etc., is charged with decorating that which would otherwise be merely useful. The term *arts of design* also applies with fair accuracy to all these arts.

This general theory of the nature of fine art, in which practically all modern artists agree so far as they have expressed in words their feeling about their art, is contradictory, or seems contradictory, to nearly all the writing about art in ancient times and in modern times down to the nineteenth century. When Homer, as in the famous description of the shield of Achilles, or Dante, as in the account of the sculptures or pictures (whichever they are meant to be; moving simulacra, perhaps) on the Mount of Purgatory, describes a work of art, the exactness of the representation of nature and of life is all that is insisted on. But the reason for this is simply that criticism was scarcely ever applied to works of the graphic and plastic arts before the nineteenth century. Men in Grecian republics admired a statue painted in vivid colors, with gilded hair, the nude parts of yellow-stained marble, the drapery blue, green, scarlet, or of the yellow stain covered thick with a pattern of dots or circles or small figures in vivid color; they told one another about the battle of the Centaurs and Lapithæ in the pediment of the Olympia Temple or the metopes of the Parthenon, and admired its artistic splendors, fancying all the while that what they admired was a representation of nature or the recording of an event. The tympanum of the thirteenth-century cathedral doorway set forth the Last Judgment, and the public and the priests cited the vigor and truthfulness of this representation of a scene which no man had seen, though each man expected to see it. But the artist who carved it and painted it in bright color and touched it with gold worked for art as single-mindedly as any self-conscious painter of our own day.

There is still the art of illustration and of pictorial description and record. There is art in the wood-cut of a new kind of steam-engine, and there is art in a picture of a juvenile book or on a postage-stamp of Columbus discovering America; but this descriptive and narrative art is not pure fine art, and it is very unusual that a good kind of fine art is found in combination with such a description or narrative.

The fine arts then are music, first and solitary, in appealing to the sense of hearing, and also in its almost complete abstraction; then the art of pure form in three dimensions, or sculpture, including all kinds of carving, modeling, chasing, and even engraving when it passes into sculpture, as in gem-cutting; then the art of color and form on a flat surface or painting, with its branches in which form alone, or form in connection with two or three tints only, is used—that is, drawing in all its forms and engraving of the usual sort with the needle or burin on smooth surfaces and the production of prints from engravings made for the purpose. Dancing may be a fine art, gardening is very often a fine art. And all these are fine arts proper, having no necessary application to any uses but those of beauty. But architecture and all those arts which are used only to adorn objects of possible utility and the great fine arts of sight themselves when so used are DECORATIVE ART (*q. v.*).

Poetry and eloquence are sometimes ranked among the fine arts. Neither of these can be absolutely separated from the other or from prose-writing.

Poetry, whether in the form of verse or not, is to be considered in the same manner as painting; it is the use of words in the noblest way to express and to excite emotion, and so far as this remains its work poetry is fine art. It is less a pure fine art than painting, because it always has something to relate or to urge; its appeals to the intellect are direct and constant, and its material or language is less artistic in itself; for we can not even conceive of poetry made up of words in unmeaning sequence, whereas colors put together without representing anything may be very lovely. On the other hand, the poetry consists not much in the subject-matter, but almost wholly in the way it is treated. A dozen men may tell a moving tale in prose and in verse, with but little poetry in any of their versions, when the same story told by a true poet is recognized quickly as a lofty work of art.

Eloquence is fine art only in so far as it gives high pleasure to the hearer by the dignity and beauty of the thoughts presented and the language in which they are presented. Argument is not fine art, convincing is not fine art; but appeals, consisting of lofty thoughts expressed in well-combined words and so addressed to the higher moral sense as to arouse men to noble deeds, can hardly fail to be considered fine art of a very lofty kind.

Writing in what is called prose may be eloquence and may be poetry, and as such becomes a work of fine art, though this is far more rarely the case than in the work of the versifier or the orator. RUSSELL STURGIS.

Fin de Siècle: a French phrase meaning end of the century, and used adjectively in the sense of peculiar to, or characteristic of, the close of the century or of the epoch; of such character as might be thought fitting to the end of the epoch—overwrought, overstimulated, artificial, and sophisticated.

Fine of Lands: a species of conveyance formerly in use in English law. It was in form a judgment of a court of justice. There was, however, no real litigation. The party against whom the action was apparently brought admitted upon the records of the court that the claim of the apparent plaintiff was just. This admission created a species of *estoppel*, so that he was prevented from afterward denying a statement thus solemnly made. This would be true, notwithstanding his title before the admission was perfect. In this way a fine might be resorted to as a conveyance. At an early day (18 Ed. I., § 4) it was required by statute that a married woman in making such an admission should declare before the court or an authorized officer, separately and apart from her husband, that she made the admission freely, and without fear or compulsion of her husband. A fine might on these principles be resorted to to "bar an entail" (see ENTAIL), though another fictitious proceeding, termed a "common recovery," was more effectual. (See RECOVERY, COMMON.) Another important use of a fine was to operate as a short statute of limitations. (See LIMITATIONS, STATUTE OF.) The rule is well expressed in the statute already referred to of 18 Ed. I.: "The fine is so high a bar and of so great force, and of a nature so powerful in itself, that it precludes not only those who are parties to the fine and their heirs, but *all other persons in the world* who are of full age, out of prison, of sound memory, and within the four seas the day of the fine levied, unless they put in their claim within *a year and a day*." In the reign of Henry VII. the time was extended to five years, and the claim must be made within that period, except in the case of persons under disability. In their case five years was allowed after the disability was removed. It was further required that there should be a proclamation of the fine in open court. This method of limitation has been in use in the U. S. with some modifications. An instance of it, when it became the support of an important title, is found in the case of *MacGregor* vs. *Comstock*, 17 New York Reports, 162 (decided 1858). T. W. DWIGHT.

Fingal, or **Fionn**: a hero of Gaelic legendary story; the father of Ossian, the heroic poet of the Gael. See MACPHERSON, JAMES.

Fingal's Cave: a remarkable cavern on the island of Staffa, off the west coast of Scotland, hollowed out in a mass of volcanic rocks. Two ranges of basaltic rocks are supported upon a lava-like mass beneath, and the unequal hardness of the materials, combined with the perfection of the columnar structure, has permitted the carving out, by the waves of the sea, of one of the most picturesque pieces of natural architecture in the world. The entrance is 42 feet wide, and 66 feet high; the length of the cave 227 feet. The Tertiary plants associated with the corresponding volcanic rocks on the neighboring island of Mull show that the eruption of these basalts occurred in the Miocene period. The beds of basalt on the coast of Antrim, Ireland, probably were but a part of the same great outpouring of lava. See GIANT'S CAUSEWAY.

Finger: See HAND.

Fingering: in music, (1) the mode or system devised for the proper use of the fingers in playing on certain instruments, as the organ, pianoforte, violin, etc.; (2) the application or practical use of such system. In elementary instruction-books and exercises for the organ or pianoforte the notes are "fingered"—i. e. accompanied by the marks x, 1, 2, 3, 4 (the x indicating the thumb), or by the figure 1 for the thumb, and 2, 3, 4, 5 for the fingers. This latter formula, sometimes spoken of as the "European fingering," has today practically superseded the "English or American fingering" with its thumb-mark x. Revised by DUDLEY BUCK.

Fin'ial [from Lat. *finis*, end]: the terminal ornament of a pinnacle, spire, or gable; also sometimes of a pointed arch. In the Middle Ages finials were important elements of architectural design, owing to the great numbers of buttresses, spires, pinnacles, turrets, and steep gables then employed, and were modeled with masterly skill in designs generally suggested by the vegetable world. The simplest and most vigorous were those of the thirteenth century in France and England; those of the fourteenth century were more elaborate and elegant; while those of the fifteenth partook of the general decadence of Gothic art. They were usually carved in stone, but leaden finials of great beauty were used on the wooden spires of churches and to terminate the ridge-crestings of hipped roofs.

Classic architecture made occasional use of roof ornaments similar to finials, the most famous examples being the florid marble *acroterium* on the summit of the choragic monument of Lysicrates at Athens. A. D. F. HAMLIN.

Finiguerra, fēē-nēē-gwăr'rāā, TOMMASO, or MASO: Italian niello-worker and goldsmith; b. at Florence, 1424; d. in 1475. To him is attributed the discovery of the art of taking prints from metallic plates on paper.

Fining, or **Clarification**: the process of clearing turbid liquors, generally used in connection with wines and malt liquors, though the process is resorted to for clearing a great variety of solutions, such as sirups, jellies, coffee, argol, etc. In the manufacture of wine and beer the yeast, which either rises to the surface as a scum or forms a deposit at the bottom, generally carries with it all suspended impurities, and leaves the liquid limpid. When this is not the case "finings" must be employed.

Filtering.—For fining small quantities of many liquors the process of filtration is the simplest. A funnel lined with porous filter-paper is the most convenient apparatus, though filters are made of a great variety of porous substances, such as cotton, flannel, earthenware, sand, charcoal, etc. Filtration is not always effective, as the impurities which render the liquid turbid are often so fine that they pass through the filter. This is generally the case with wines and malt liquors. Another objection to filtration is the difficulty of conducting it without exposing the liquor to the air, which in the case of light wines and malt liquors would be fatal.

Isinglass, or gelatin, is most frequently employed for beer and ale. "Brewers' finings" are made by softening the gelatin in four times its weight of cold water or sour beer. As the gelatin swells, more water or sour beer is added. The thick jelly thus obtained is dissolved in eight times its volume of the liquor to be fined, when it presents the consistence of a sirup; 1 lb. of isinglass makes about 12 gal. of finings. This is added in about the proportion of 1 to 2 pints to a barrel of ale or to a hogshead of cider or wine. The gelatin is coagulated, or rendered insoluble, by the astringent tannic acid of the liquor, and as the insoluble compound gradually settles to the bottom of the barrel, it inviscates and carries with it all the suspended impurities, and leaves the liquor clear. In some cases this removal of the astringent principle is objectionable, as it modifies the flavor and diminishes the keeping qualities of the liquor. In the case of red wines this is so important a consideration that albumen is employed instead of gelatin. Coffee is often clarified by the addition of a piece of the skin of salted codfish, which furnishes gelatin which is coagulated by the tannic acid present. Carrageen moss is sometimes used for clarifying beer, as are also the dried stomachs of the cod, called *sounds*. *Lime* in the water used is supposed to aid materially in the clarification of beer by combining with the acids of the malt, forming insoluble salts, which carry down the suspended matters. The spring water used in the breweries at Burton-on-Trent in England contains a considerable quantity of sulphate of lime, which is thought to aid in clearing the ales.

Albumen is coagulated either by heat or by alcohol. It is used in large quantities by sugar-refiners, who clarify or "defecate" their solutions of raw sugar with bullock's blood. The blood is added while the solution is below 140° F., and then, on raising the temperature to a boil by means of steam, the albumen of the blood is coagulated, and the coagulum, forming flocks, collects and envelops the suspended impurities, and partly rises to the surface as a scum, to be skimmed off, and partly settles to the bottom, to be separated by the "bag filters."

In making calf's foot jelly fresh egg-shells are often thrown in, that the adhering albumen may be subsequently coagulated by heat and clear the liquid, from which the shells and coagulum are separated by a bag filter of flannel. When albumen is added to wines it is coagulated by the alcohol, and operates as when coagulated by heat. Heat alone clarifies many vegetable and animal juices by coagulating the albumen which they naturally contain.

Vegetable acids clarify many expressed juices, and the juice of sour cherries will completely separate the pectin of currant and raspberry juice so as to fit them for sirups.

Alum is sometimes used. It is especially serviceable in clarifying waters which are rendered turbid by fine mud, a pinch of alum thrown into a barrel of water being sufficient to render it clear and limpid after a few hours' standing. The alumina is probably precipitated by the carbonate of lime, which is always present in river as well as in spring water.

Acetate of lead has been used for clarifying liquors, its precipitation being effected by a subsequent addition of half its weight of sulphate of potassa. It is a very dangerous agent on account of its poisonous character.

Plaster-of-Paris, clay, sand, and *marl* are often effective in clarifying turbid solutions, such as cider, etc.

Soluble salts, as a solution of sal-ammoniac, often cause the separation of finely divided precipitates, which remain long in suspension in pure water. They also greatly facilitate the filtering and washing of precipitates, which otherwise pass through the filter.

Finistère, fi'ni-stār', or **Finisterre** [Fr., from Lat., end of the land; *fi'nis*, end + *ter'rae*, gen. of *ter'ra*, land]: department of France, comprising the western part of the former duchy of Bretagne. Area, 2,595 sq. miles. Its coasts along the English Channel and the Atlantic are formed of rugged and broken granite rocks, but in the interior the soil is fertile and well cultivated. Its silver and lead mines are very valuable. Pop. (1896) 739,648.

Finisterre, Cape: a promontory at the northwestern extremity of Spain; lat. 42° 54' N., lon. 9° 21' W.

Finisterre Mountains: See the Appendix.

Finite Difference: in mathematics, the difference between two values of a variable quantity; generally the amount by which the quantity increases in consequence of an increase of unity in the variable on which it depends. For example, if the quantity is n^2, then an increase of n by unity changes the quantity to $(n+1)^2$. The excess of this over n^2 is the finite difference of n^2, found thus:

$$\begin{array}{ll} & (n+1)^2 = n^2 + 2n + 1. \\ \text{Subtract} & \quad n^2 = n^2 \\ \text{Finite difference of } n^2 = & \qquad 2n + 1. \end{array}$$

The finite difference of a quantity is represented by the symbol Δ before the symbol of the quantity. Thus the last result is written $\Delta(n^2) = 2n + 1$.

The increase of the original quantity (n in this example) is not necessarily unity; it may be anything whatever, and may be called Δn. We should then have, for the value of $\Delta(n^2)$,

$$\Delta(n^2) = (n + \Delta n)^2 - n^2 = 2n\Delta n + (\Delta n)^2.$$

A finite difference differs from a differential only in not being supposed infinitesimal. The calculus of finite differences treats of the theory of the subject, which has many practical applications. An excellent English treatise on the subject is that of George Boole (London).

Simon Newcomb.

Fink, Albert: civil engineer; b. near Frankfort-on-the Main, Germany, Oct. 27, 1827; studied at the Polytechnic School in Darmstadt, and in 1849 went to the U. S. He introduced the bridge system known as the "Fink truss," and in 1869 he built the great bridge over the Ohio at Louisville, Ky. (See Bridges.) For many years he was identified with the management of the Baltimore and Ohio Railroad and the Louisville and Nashville Railroad as superintendent and engineer. In 1875 he organized the Southern Railway and Steamship Association, and in 1877 he became the commissioner of the trunk lines centering at New York, which position he resigned in 1888 on account of failing health. In 1890 he was president of the American Society of Civil Engineers. D. near Sing Sing, N. Y., Apr. 3, 1897.

Finland [< O. Eng. *Finna land*, land of the Finns. Cf. Icel. *Finnland*; *Finnr*, Finn + *land*, land, but perhaps orig. *fenland*, transl. of the Finnish name *Suomenmaa*, lakeland, Finland]: a grand duchy of Russia, lying between lat. 59° and 70° N. and lon. 21° and 33° E., and bounded by Russia, Norway, Sweden, and the Gulfs of Bothnia and Finland. It includes a portion of Russian Lapland. Area about 144,255 sq. miles, one-third of which is occupied by lakes and marshes; pop. (1895) 2,483,249. The ground may be generally described as a table-land from 400 to 600 feet high, with occasional elevations, depressions, and ranges of hills covered with dense forests of fir and pine, which, in connection with the beautiful lakes, give the country a picturesque and romantic though somewhat somber aspect. The coast is low, except the southern part, which presents a line of rugged cliffs skirted with innumerable rocky islands. While Finland was united to Sweden it exported yearly a great quantity of rye and barley; indeed, it was called the "granary of Sweden." But since its annexation to Russia it has largely given up agriculture and has taken to cattle-breeding, for which the country in many places is eminently adapted. The most valuable exports are, however, the products of its forests, as timber, pitch, potash, tar, and rosin. It yields also some copper, iron, lime, and slate. Reindeer, wolves, elks, beavers, various kinds of game, and, among fishes, salmon, trout, and herring, abound. The climate is rigorous. A severe winter of seven or eight months passes through a short spring immediately into a hot, dry summer. About 84 per cent. of the population are Finns, the balance being Lapps, Swedes, Russians, Germans, and gypsies. The Finns are a branch of the Ugrian race, kindred to the Laplanders and the Magyars of Hungary, but different both from the Swedes and the Russians. They are tall, strongly built, and well proportioned, but the shape of their faces is nearer the square than the oval, and their features do not indicate any high degree of intellectuality. They are an honest, industrious, and energetic people, however, and their peculiar language and literature have attracted much attention. Along the coast the inhabitants have generally given up their peculiar dress and customs, but toward the interior primitive customs still prevail. The residences here greatly resemble the old American blockhouses. In olden times the Finns formed an independent empire, but in the twelfth century they were conquered and converted to Christianity by the Swedes. During the union with Sweden the Swedish language and civilization took deep root among the Finns, and when in 1809 Russia finally conquered and secured the country, she was met with great opposition and aversion by the people. The Swedish was the official language down to 1863. Russia has governed the country with great prudence, granting the Finns many privileges, and her attempts at eliminating the Swedish elements by supporting and developing the original Finnish foundation have been somewhat successful. In the popular schools, as a rule, Finnish is the medium of instruction. All the native population are able to read and write. The most important towns are Helsingfors, Åbo, Sweaborg, and Viborg. The Emperor of Russia is Grand Duke of Finland. The state Church is Lutheran. The government is nearly independent of the rest of the Russian empire, and is administered in accordance with the Finnish constitution of 1772. The country has an independent system of coinage, the unit being the mark = one franc. See Finland in the Appendix. Revised by C. H. Thurber.

Finland, Gulf of: the great eastern arm of the Baltic; situated between lat. 59° and 61° N. and lon. 22° and 30° E. Its water is only very slightly salt, having come from the great lakes Onega, Ladoga, Peipus, and Saima through the river Neva. At its east end is St. Petersburg, and along its coasts are Narva, Reval, Frederikshamn, Helsingfors, and Viborg.

Finlay, George, LL. D.: historian; b. of Scottish parents near Faversham, England, Dec. 23, 1799; studied at Glasgow and Göttingen. In 1823, before the death of Lord Byron, he joined the Greeks in their struggle for independence, and spent the remainder of his life in Greece, studying its history and antiquities. He wrote *Greece under the Romans, 146 B. C. to 716 A. D.* (1843; 2d ed. 1856); *History of the Byzantine Empire, 716–1057 A. D.* (1852; 2d ed. 1856); *History of the Byzantine and Greek Empires, down to 1453 A. D.* (1854); *History of Greece from its Conquest by the Crusaders to its Conquest by the Turks, 1204–1566 A. D.*, and of *The Empire of Trebizond, 1204–1461* (1851); *History of Greece under Othoman and Venetian Domination, 1453–1821 A. D.* (1856); *History of the Greek Revolution* (1861; rev. ed. 1877). D. at Athens, Jan. 26, 1875.

Finley, John Huston: See the Appendix.

Finley, Lieut. John Park: special student of and writer on tornadoes; b. at Ann Arbor, Mich., Apr. 11, 1854; educated at the State Normal School and State Agricultural College of Michigan; received the degree of M. S. from the latter. He has been assistant to the chief signal officer and officer in charge of the Pacific coast division of the Weather Service. Among his numerous papers may be mentioned *Tornadoes* (1887); *Manual of Instruction in Optical Telegraphy* (1889); *Sailor's Handbook of Storm-track, Fog, and Ice Charts of the North Atlantic and Gulf of Mexico* (1889); *Prize Essay on the Development of Tornadoes* (1890).

Finley, Samuel, D. D.: Presbyterian clergyman and president of the College of New Jersey; b. in County Armagh, Ireland, 1715; arrived in Philadelphia, Pa., Sept. 28, 1734; was licensed to preach Aug. 5, 1740, and was ordained at New Brunswick, N. J., Oct. 13, 1742. He began his ministry during the religious revivals of the time, and having preached at New Haven, Conn., in violation of a law forbidding itinerants to preach in the parishes of settled ministers without their consent, in Sept., 1743, he was seized and carried as a vagrant beyond the limits of the colony. From July 14, 1744, to 1761, he was pastor and teacher of an academy which he established at Nottingham, Md. In July, 1761, he was chosen president of the College of New Jersey at Princeton, N. J. He published sermons and edited those of his predecessor, President Davies. D. in Philadelphia, Pa., July 17, 1766.

Finmark [*Finn* + *mark*, boundary < O. Eng. *mearc* : Germ. *Marke* : Dan. *marke*]: province of Norway, comprising the northernmost part of continental Europe; between lat. 68° 30′ and 71° N. and lon. 17° and 31° E.; area, 24,000 sq. miles. Finmark is a high table-land, sometimes rising 3,000 feet above the level of the sea, indented by numerous deep, narrow, winding fiords, and skirted with innumerable islands. As agriculture becomes impossible at an elevation of 100 feet, at which height only a few wild berries will ripen, almost the only sources of wealth which the inhabitants possess are the reindeer and the codfish. Pop. (1891) 29,332, mostly Lapps. The principal town is Hammerfest, the northernmost city of Europe.

Finney, Charles Grandison: Congregational clergyman and college president; b. at Warren, Conn., Aug. 29, 1792; removed to Oneida co., N. Y.; studied law, but was ordained as a minister in 1824. He was specially noted as a revivalist. In 1835 Mr. Finney became a Professor of Theology at Oberlin College, Ohio, and its president in 1852, holding that office until 1866 and the former till death. In 1837 began his pastorate of the college church. In 1848–51 preached in England. Published *Lectures on Revivals* (Boston, 1835; ed. with notes, Oberlin, 1868); *Lectures to Professing Christians* (Oberlin, 1836); *Sermons on Important Subjects* (New York, 1839); *Lectures on Systematic Theology* (2 vols., Oberlin, 1847; London, 1851; n. e. Oberlin, 1878); *Character of Free Masonry* (Cincinnati, 1869); *Autobiography* (Oberlin, 1876); *Sermons on Gospel Themes* (1876). D. in Oberlin, O., Aug. 16, 1875. See his *Life* by G. F. Wright (Boston and New York, 1890).

Revised by S. M. Jackson.

Finnish Language (*Suomen Kieli*, lit., Finland's language): one of the chief representatives of the Ugro-Finnic group of tongues; spoken in Finland by about 1,750,000 people, and also in portions of Sweden, Norway, and Russia. While Finland was subject to Sweden, Swedish was the official language of the land, but since the conquest of Finland by Russia there has been developed a political and literary movement known as Fennomania, which is an effort warmly supported by the Russian Government to establish Finnish as the language of the land. The oldest written monuments of Finnish date no further back than to the year 1541, in which the Lord's Prayer was printed in Seb. Münster's *Cosmographey*. The first Finnish book was Michael Agricola's *Primer*, which appeared in 1542. The same author also published several religious and moral tracts. Later publications of importance to the student of Finnish language are the translation of King Kristoffer's *Law* (1610), and the Finnish version of the Bible begun by Bishop Agricola, but completed by other hands in 1642. See Finnish Literature.

The most conspicuous feature of the Finnish language is its wealth of vowels and diphthongs, a fact which led the celebrated linguist Rasmus Rask to proclaim it the most harmonious and sonorous of all tongues. Consonants are used most sparingly. In the written language phonetic spelling is employed with almost perfect consistency. The accent is always on the first syllable regardless of the length of the word. Nouns have no gender, and are declined in singular and plural through fifteen cases, six of which are local cases, e. g. *maalla*, on the earth; *maassa*, in the earth; *maalle*, to the earth; *maahan*, into the earth; *maalta*, from the earth; *maasta*, out of the earth. A suffix takes the place of the possessive pronoun, thus: *taloni*, my home; *talosi*, thy home; *talossani*, in my home; *talossasi*, in thy home. The negative is omitted with the stem of the verb and conjugated with it, thus, *en tule*, I do not come; *et tule*, thou dost not come; *emme tule*, we do not come. The verb has only two tenses, present and past, the future being formed periphrastically by the aid of the present. In the formation of words onomatopœic changes are made almost without end, e. g. the endless variations of a creaking, cracking, crashing sound are expressed by *ratisee*, *rätisee*, *ritisee*, *rotisee*, *rutisee*, *rotajaa*, *rutajaa*, etc. In terminal formatives Finnish is even far richer than Greek or Italian. Thus from *pieni* = little, we have *pienoinen*, *pienuinen*, *pienulainen*, *pienukainen*, *pienimminen*, *pienimäinen*, *pienemmäinen*, and several other modifications easily distinguished by a trained Finnish ear; besides, the above forms do not include the comparative and superlative degrees. This wealth of terminal formations is particularly important in connection with the verbs, which are made frequentative, factive, intransitive, momentive, etc., *ad libitum*.

There are several Finnish dialects, of which the East Finnish or Karelian, the Savolak, the East Bothnian, the Tavastland, and the West Finnish are the most important. In the capital, Helsingfors, there is a society for the promotion of the Finnish language (*Kotokielen seura*), the leader of which is the distinguished poet and linguist A. E. Ahlquist. The Tavastland dialect is now accepted as the basis of the written language, although the epic *Kalevala* is written in East Finnish, and C. A. Gottland desired the adoption of the Savolak dialect. Finnish and Swedish are now equally recognized in the schools, churches, courts, theaters, and newspapers of Finland, and Finnish is also employed in scientific works. The Finnish folk-songs consist of verses of eight syllables (four trochees), the foot being determined by the quantity, not by the accent. There is a peculiar periphrastic repetition of the same idea through several verses, similar to that found in Hebrew poetry. Rhymes rarely occur, but the verses abound in alliteration, which the Hungarian P. Hunfalvy regards as original, but which Ahlquist declares to be borrowed from old Norse literature. The first Finnish grammars were published by Eskil Petræus in 1649 and by Martinius in 1689. A vocabulary was collected by E. Schroderus and published in 1632. In 1821 appeared a new edition of Barthold Vhael's *Grammatica Fennica*, originally published in 1733. G. Renvall wrote treatises on Finnish orthoëpy, orthography, and meter, and published a Finnish dictionary in 1826 and a Finnish grammar in 1840. Lönnrot's great Finnish-Swedish dictionary was begun in 1866 and completed in 1880. Other dictionaries are that by G. E. Euréns (Finnish-Swedish), published in 1860, and that by F. Ahlman (Swedish-Finnish), of which the second edition appeared in 1872. Later grammars have been given by G. E. Euréns (1849), by A. W. Jahnsson (1871), and by Y. Koskinen (1860). Contributions to the history of the development of the Finnish language have been written by A. E. Ahlquist, S. G. Elmgren, and O. Donner.

Rasmus B. Anderson.

Finnish Literature: the literature of the Finnish people. This begins with the dedication of a university at Åbo in 1640 and the establishment of the first printing-press in Finland two years later. The scattered literary efforts during the preceding century were printed in other countries. The Lutheran Reformation was introduced in Finland about 1538, and there, as elsewhere, was followed by efforts to make religious knowledge accessible to the public. Thus came Bishop Michael Agricola's *Primer* (1542), his *Prayer-book* (1544), and his translation of the New Testament (1548), together with a number of other religious manuals and translations from the Old Testament. Another prayer-book and also a hymn-book appeared in 1583. In 1625 Ericus Erici published a book of sermons and in 1630 a *Catechism*. The learned Bishop Paulus Juusten (d. 1576) left an unpublished history of the Finnish bishops (*Chronicon episcoporum Finlandensium*), which was afterward printed in Nettelbladt's *Schwedische Bibliothec* (1728), and by Porthan (1784–99). This *Chronicon* is most valuable, and constitutes the chief source of Finland's early history. Klas Hermansson Fleming (d. 1616) and Johan Messenius (d. 1636) wrote extensively in Swedish on Finland, the latter devoting a tenth part of his *Scondia Illustrata* to this country, by reason of which he is usually styled "the father of Finnish history." In Sigfrid Aroni Forsius (d. 1627) Finland produced an eminent astronomer and mathematician, who prepared eleven almanacs, the last (1623) giving all the calculations for the Åbo latitude. Forsius wrote exclusively in Swedish. Another prominent scholar of this early period was the Bishop Eskil Petræus (d. 1657), the author of the first Finnish grammar.

As has been stated, the first printing-press was set up at Åbo in 1642. A second was established there in 1668, and in 1688 Viborg secured the third printing establishment. The literature that came from these presses was considerable in quantity, though usually inferior in quality. As early as 1642 the first complete translation of the Bible into Finnish left the Åbo press. This was the great folio edition; the translation was begun by Agricola and finished by Petræus. Thirty years later the founder of the second press at Åbo, J. Gezelius the Elder (d. 1690), and his son J. Gezelius the Younger (d. 1718) began the publication of a Swedish translation of the Bible, of which the New Testament appeared in 1713 and the Old Testament in 1728. The younger Gezelius also issued a new revised edition of the Finnish prayer-book, which appeared in 1701, and is still used in Finland without any subsequent revision. This period produced a large number of books of sermons by Eskil Petræus, Isak Rothovius (d. 1652), Olof Arenius (d. 1682), and Gabriel Vallenius (d. 1690). The scientific works of this age were usually written in Latin, and the chief topic was theology. Among writers of this class we find E. Svenonius (d. 1688), J. Terserus, J. Flachsenius, and the father and son Gezelius. The elder Gezelius also published a philosophical cyclopædia. Philosophy was represented by A. Thuronius, Axel Kempe, and the polyhistor M. Wexionius (d. 1670), whose *Etica* and *Politica* made their author famous. He also wrote a short geography of Finland. Philology was also studied, and brought forth the first Swedish and the first Finnish grammar. The seventeenth century produced one botanist of note, Elias Tillandz, and one antiquarian, Elias Brenner (d. 1717), who wrote a *Thesaurus nummorum Sveo-Gothicorum*. The conquest of Finland by Sweden in the twelfth and thirteenth centuries brought Swedish culture, and with it the Swedish language, into the country, and at the same time many Swedes settled in Finland. On the other hand, Finland has contributed much to the historical development of Sweden; and a number of the great men of Sweden—Arvid Horn, Armfelt, Reuterholm, and others—were Finlanders by birth. The university naturally had to look to Sweden for its professors, particularly in its infancy; and the university being the center of intellectual activity, Swedish influence became supreme. The Swedish element developed a literary activity in all directions, and in course of time produced poets and scholars of the highest rank. Indeed many of the native-born Finlanders, like Franzén, Runeberg, and Topelius, writing in Swedish, became the chief creators of the literature of Sweden. See SWEDISH LITERATURE.

In the seventeenth century the influence of the Swedish element was seen chiefly in the introduction of lyric poetry and the so-called students' dramas (J. Chronander, P. Carstenius, D. Achrelius, J. Paulinus, and T. Rudén).

The ravages of the great war against Peter the Great (1710–20) reduced Finland's population from three-quarters to one-quarter of a million, and caused a serious interruption in the development of Finnish literature. By the Nysted peace (1721) Viborg was ceded to Russia. Finland gradually regained her prosperity and former population, and Finnish literature entered upon a new era, in which particular attention was paid to practical, economic, and scientific subjects. Swedish and Finnish now became rivals of the Latin language in the presentation of these. The new epoch produced the eminent theologian and philosopher Johan Browallius (d. 1755); the botanist Peter Kalm (d. 1779), who was Linné's pupil, and who, at the request of Linné, visited North America (Sept., 1748, to Feb., 1751) for the purpose of studying its flora. He embodied the results of his researches in three volumes, called *En resa till Norra Amerika* (*A Journey to North America*); the chemist and mineralogist Peter Adrian Gadd (d. 1797); the economist Anders Chydenius (d. 1803), who has the honor of having defended in his published works the same principles as the celebrated Adam Smith. Poetry was represented in this epoch by Abraham Achrenius (d. 1769) and Gustaf Filip Creutz (d. 1785), the former writing hymns in Finnish, the latter pastoral poems in Swedish.

The Gustavian epoch so celebrated in Swedish literature did not begin to bloom in Finland until its flowers had already commenced to fade in Sweden. The chief Finnish poet of this period, Frans Mikael Franzén (b. 1772; d. 1847), was not only the first great poet of Finland, but he also attained the rank of one of the most eminent lyric skalds in the annals of the literature of Sweden. Other poets of this epoch were Mikael Choræus (b. 1774; d. 1806); Jakob Tengström (b. 1775; d. 1832), known also as an historian; and Henrik Gabriel Porthan (b. 1739; d. 1804), whose poems are forgotten, but whose labors in the cause of the Finnish language secured him undying fame. This age also produced the great jurist Matthias Colonius (1737–1817); the philosopher G. I. Hartman (d. 1809); the mathematician A. J. Lexell (d. 1784); the physicist G. G. Hällström (d. 1844); and the great chemist and mineralogist Johan Gadolin (d. 1852).

In 1809 all of Finland became a province of Russia. It seemed at the outset as if the Russian conquest would be a blow to Finland from which it would not soon recover; but after the university had been removed from Åbo to Helsingfors, the new capital, in 1828, Finland entered upon her most brilliant intellectual period, producing scholars, poets, and artists of whom any nation in any age might be proud. The first to kindle the new enthusiasm and activity was Adolf Ivar Arwidsson (1791–1858), the poet, publicist, and historian. His writings roused the people to a love of their country, their language, and their history hitherto never known. He fought for the rights of the Finnish tongue as the vehicle of Finnish thought, though the scientific study of the language itself had already been begun by G. Renvall (d. 1841) and by R. v. Becker (d. 1858). Scholars now undertook the collecting of songs and tales from the mouths of the common people, the grandest results in this direction being attained by the celebrated Elias Lönnrot (b. 1802; d. 1884), who published in 1835 the extensive popular epic *Kalevala* (see KALEVALA); in 1840 a collection of popular lyrics called *Kanteletar* (the Finnish harp is called *kantele*); and in 1880 a volume of troll-runes. The discovery and publication of all this popular poetry suddenly shed a flood of light upon the mythic past of the Finns, and gave a mighty impetus to the conflict which is still raging between the Fennomans and the advocates of Swedish. Much credit is due in this connection to the Finnish literary society (*Suomalaisen Kirjalisuuden Seura*) organized in 1831. Besides publishing the popular literature already mentioned, this society founded a magazine, the *Suomi*, of which more than forty volumes have appeared. In the meantime Finnish poetry began to flourish as never before. Its chief representative is August Engelbrekt Ahlquist (b. 1826), who is at the same time the foremost authority in Finnish philology. Swedish literature in Finland also felt the influence of the new movement. Its greatest ornament is Johan Ludvig Runeberg (b. 1804; d. 1877). By his imperishable verse he not only became the strongest pillar of Swedish culture in Finland, but he will forever be counted as one of the greatest poets that the whole North has produced, ranking easily with Tegnér, Oehlenschläger, or Welhaven. In his *Stories of Ensign Stål* he immortalized Finland's last conflict in a series of pictures of wonderful beauty. Next after Runeberg ranks Zacharias Topelius (b. 1818), a poet of the highest order, and Finland's most popular novelist. His *Surgeon's Stories* (6 vols.) have been translated into many languages, and are everywhere the delight of the reading public, but the discussion of Franzén, Runeberg, and Topelius belongs under Swedish as much as under Finnish literature. Other poets of this period are Fredrik Cygnæus (1807–81), a lyric and dramatic writer too deep to be popular; Lars Jakob Stenbäck (1811–70); Johan Jakob Nervander (1805–40); Emil von Quanten (b. 1827); Josef Julius Wecksell (b. 1838), author of the tragedy *Daniel Hjort*; Karl Robert Malmström (b. 1830); and Theodor Lindh (b. 1833). The removal of the university to Helsingfors also brought forth a number of distinguished scholars, among whom were Johan Jakob Nordström (d. 1874), an historian of great ability; Mathias Alexander Castrén (d. 1852), Professor of Finnish and translator of *Kalevala* into Swedish; Georg August Wallin (d. 1852), explorer and linguist; Gabriel Rein (d. 1867), Matthias Akiander (d. 1871), and G. Z. Forsman, the last three historians; Johan Vilhelm Snellman (d. 1881), philosopher; and Carl Gustaf Estlander (b. 1834), writer on arts and æsthetics.

Finnish literature has been exhaustively treated by S. G. Elmgren in his *Review of Finland's Literature* (1865), and by Gabriel Lagus in his *Lectures on the Development of the Finnish-Swedish Literature* (1867). Very comprehensive articles on Finland, its history, language and literature, are published in vol. iv. of *Nordisk Familjebok* (1881), and to this work the present writer is largely indebted for his materials.

RASMUS B. ANDERSON.

Finsbury, or **Fen Town**: See LONDON.

Finsch, FRIEDRICH HERRMANN OTTO, Ph. D.: German ornithologist and explorer; b. Aug. 8, 1839, at Warmbrunn, Silesia, Prussia. Educated for a mercantile life, he seized the first opportunity to indulge his love of travel and natural history by accepting a position with the Austrian consul at Rustschuk. From 1861 to 1864 he was assistant in the Museum of Leyden, Holland, and at the end of that time was appointed director of the Museum of Natural History and Ethnology at Bremen. In 1878, under the auspices of the Bremen Society for North Polar Exploration, he made a journey through Western Siberia accompanied by Dr. A. E. Brehm, author of *Das Thierleben*, and explored the tundra between the Obi and the Gulf of Kara, in the hope that it might be feasible to unite tributaries of the Obi and Kara rivers with a canal. Aided by the Humboldt Society of Berlin, Dr. Finsch spent the period of 1878–82 in Australia, New Guinea, and other islands in the Pacific, where he made large collections. On his way to Australia viâ the U. S. he supervised the transportation of live carp to Washington, the progeny of which, through the efforts of the U. S. Fish Commission, have been distributed throughout the U. S. In 1884–85 Dr. Finsch again visited New Guinea, this time in the interest of a Berlin syndicate, explored and surveyed the coast from Vulcan island to Humboldt Bay, the result being the establishment of the German protectorate over what is known as Kaiser Wilhelmsland. Among his many publications are *Monographie der Papageien*; *Die Vögel Ostafrikas* (in conjunction with Dr. Hartlaub, 1870); *Die Zweite deutsche Nordpolarfahrt.*, part iv., *Vögel* (1873); *Anthropologische Ergebnisse einer Reise in der Südsee* (1884); *Verzeichniss einer Sammlung von Maori Antiquitaten auf Neuseeland* (1884); *Über Bekleidung, Schmuck und Tättowierung der Papua auf der Südostküste von Neuguinea* (Vienna, 1885, mit Abbildungen); *Ethnologische Erfahrungen, etc., aus der Südsee* (1888, 1891, 1893); *Ethnologischer Atlas, Typen aus der Steinzeit Neuguineas* (1888).

Finsch Haven: See the Appendix.

Finsteraar'horn: the highest peak of the Bernese Alps, Switzerland, 14,026 feet high.

Fiords, fyōrds [from Dan. *fjord*: Icel. *fjörðr*, pl. *firðr*, whence Eng. *firth*, *frith*: Germ. *Furt*: O. Eng. *ford* > Eng. *ford* < Teuton. *ford-*: Lat. *portus*, harbor, whence Eng. *port* < Indo-Eur. *per-*, *por-*, go, cross, beyond > Sanskr. *par-*, cross, Gr. *πόρος*, passage, *περάω*, cross, *πόρθμος*, ferry, Eng. *fare*, ferry]: narrow and deep arms of the sea, penetrating a mountainous coast. Fiords characterize the coasts of Norway, Scotland, Greenland, Labrador, British Columbia and Southern Alaska, Southern Chili, and Southern New Zealand, and to a less degree the coasts of Maine, Nova Scotia, etc. They are produced by the submergence of valleys, excavated by atmospheric weathering during a former higher stand of the land, and frequently more or less modified afterward by glacial action. The irregular Austrian coast of the Adriatic and the ragged coast of Greece illustrate the effect of submergence of rugged lands, unaffected by glacial action. The great fiords of Norway differ from shallow inlets, such as those of Chesapeake Bay, chiefly on account of the difference in the relief of the two submerged regions. See COAST. W. M. DAVIS.

Fiore, PASQUALE: See the Appendix.

Fiorelli, fē̄e-ō-rel'lē̄e, GIUSEPPE: archæologist; b. at Naples, Italy, June 8, 1823; won early fame as a director of the Pompeian explorations, but was displaced on account of his liberalism. After Victor Emmanuel came into possession of Southern Italy, Fiorelli was made (1860) chief director of the operations at Pompeii, and later chief director of the excavations of the whole kingdom; also Professor of Archæology in the University of Naples. In 1865 he was elected senator. Was editor of the *Giornale dei Scavi*, and published maps and reports of his work, some of them extensive and important productions. D. Jan. 29, 1896.

Fir [M. Eng. *fir*, *fur*, from Dan. *fyr*: O. Eng. *furh* (in *furh-wudu*, fir-wood): O. H. Germ. *forha* > Mod. Germ. *Föhre* < Teuton. *forh-*; cf. Lat. *quercus*, oak]: the English name for all coniferous trees of the genera *Abies* and *Picea* (and in Great Britain even the native pine is called Scotch *fir*, but incorrectly); but there is a prevailing tendency to restrict the name to the group represented by the silver fir of Europe (*Abies pectinata*), the balsam firs of Atlantic North America (*A. balsamea* and *A. fraseri*), and the noble *A. grandis*, *A. amabilis*, and *A. nobilis* of Oregon and California; i. e. to those species which bear lateral and erect cones, the scales of which at maturity fall away with the seeds. Most of these yield fir balsam. (See BALSAM, CANADA.) The numerous species of the other main division properly take the name of *spruce*. These are known by their cones hanging from the tips of branches and their scales remaining permanently attached to the axis. There is a peculiar group of spruces or spruce-firs represented in the Northern Atlantic U. S. by the hemlock spruce (*Tsuga canadensis*), and in and W. of the Rocky Mountains by the noble Douglas spruce (*Pseudotsuga douglasii*). Fir timber generally is light, soft, and white; that of some species is excellent for masts and spars, but not otherwise of high value. That of the spruce is more valuable than that of the proper firs, excepting, however, the European silver fir. This genus furnishes some of the best and most available evergreen trees for ornamental planting. As to the Northern and Middle U. S., to which they are mainly adapted, the commonest and one of the best spruce firs is the Norway (*Picea excelsa*), much excelling the native black spruce (*P. nigra*), but it is excelled for all northern regions by the beautiful white spruce (*P. alba*) and by the Menzies spruce (*A. menziesii*) of the Rocky Mountains. As to the true firs, the balsam firs of North America are very short-lived; the European silver fir is apt to die down from the winter, at least when young; and it remains to be seen whether any of the magnificent Western species are sufficiently hardy to be generally planted with success.

Firdausī, fẹ̄er-dow'sē̄e (sometimes also *Firdusi* and *Ferdosee*): Persian epic poet of the tenth century A. D., and author of the *Shāh-Nāmah*, or Book of Kings, a national history of Iran. The poet's real name was Abū'l Kāsim Mansūr; the name Firdausī, Paradise, by which he is known to fame is apparently a *nom de plume* or complimentary title given him, it is believed, by his patron Sultān Mahmūd, but other explanations of the name are found.

The main facts of Firdausī's life are fairly certain. He was born near Tūs, in Khorassān, about A. D. 940 (Hijrah 329). By birth he came of good stock; his family, though perhaps in moderate circumstances, were of the Dihkan class, or old landed proprietors in Persia, whom the Arab conquest had not displaced. In the Dihkan families the old legends and historical traditions were kept alive; the name *Dihkan* became therefore synonymous with historian. Firdausī would thus naturally have an inherited aptitude for the subject he was destined so nobly to treat. That he had a good education is shown by his mastery of Arabic and Persian, and his evident familiarity with the obsolete PAHLAVI (*q. v.*). At the age of twenty-eight he married, and of his two children the younger, a daughter, survived him.

Firdausī's real literary career seems to have begun at the age of thirty-six, when he entered upon his life-work, the composition of the *Shāh-Nāmah*, to deal with which he was eminently qualified alike by his extended studies, his inherited sympathy, his devoted zeal, and his poetic talents. Abundant historical material must have existed in Firdausī's day out of which the annals of ancient Persia could be constructed. Chronicle histories of Media and Persia appear to have been kept from the earliest times, if Herodotus and Ktesias, Moses of Khorene, as well as the statement of the Bible, Esther vi. 1, x. 2, are to be believed. Under two of the last Sassanian monarchs, Nushirvan (Khosrav Anōshirvān, A. D. 550), and especially Yezdegerd (about A. D. 625), collections of these annals are said to have been begun. The historian Danishvar, one of the Dihkan class, under the last-mentioned ruler compiled a chronicle history, the *Khotai-Nāmak*, Book of Kings, in the Pahlavi language. Three centuries after the Moslem conquest a court poet, Daḵīḵī, who flourished about A. D. 975, under the last of the Sāmanian princes, had begun a national epic dealing especially with the reign of Gushtasp and the establishment of the religion of ZOROASTER (*q. v.*), but he had been murdered. There was an opening thus created for a national poet; Firdausī seems to have been filled with the ambitious design of striving to gain that honor. Through a friend, as he relates, he procured a copy of the old Pahlavi chronicle of kings, and immediately began work upon his cherished theme. For more than twenty years Firdausī seems to have worked upon the subject at his home in Tūs. His fame doubtless grew, and when in the poet's fiftieth year a new monarch and zealous patron of letters, Mahmūd of Ghazni or Ghazna (A. D. 997–1030), came to the throne, it is natural that not a long time should have elapsed before Firdausī was installed at court.

Many interesting anecdotes are preserved about Firdausī's life at court, and his skill shown in poetic contests. The delighted Mahmūd treated the laureate royally, and promised him 1,000 gold pieces for each thousand couplets of his epic as they were completed. Firdausī preferred to have the payment reserved until the great work was finished. His design was to spend the entire sum in improving the dikes of his native city.

For at least twelve years Firdausī lived at court and continued his work under Mahmūd's patronage; but jealousies were rife, and enemies had meanwhile arisen. The poet was seventy years of age when his monumental work of 60,000 couplets, or 120,000 lines, was finished. He presented it to the sultan through his friend Ayaz. The monarch ordered an elephant to be laden with 60,000 gold pieces and sent to the poet-laureate. But the sultan's jealous vizir, the knavish Hasan Meimendi, persuaded Mahmūd to change his decision and to substitute 60,000 silver dihrems for the gold. Firdausī, as the story goes, was in the bath when the gift arrived. He received it with joy, but on discovering the deception and the broken promise, he fell into a furious rage. He at once divided the money into three parts, giving 20,000 to Ayaz, and distributing the remaining 40,000 silver pieces equally between the bath-steward and a servant who brought him a glass of cordial. He then sent back a reproachful message to Mahmūd. The latter, incensed, ordered Firdausī to be put to death, but on the morrow revoked this cruel mandate. The aged poet, however, in bitter despair fled from Ghazni, leaving behind him a satire which on the spur of the moment he had composed against Mahmūd. This satire, which has been preserved, destroyed all the effect of the poet's former noble panegyric on the prince, and has ever lasted as a tarnish upon the name of Mahmūd.

For the ten years that remained of his life, Firdausī seems to have been a wanderer. He went first to the region of Māsandarān; thence he betook himself to the Khaliph Kader-billah of Baghdad, by whom he was hospitably received, and for whom he composed a poem of 9,000 couplets on the love of *Yūsuf and Zuleikha*, a version of the story of Joseph and Potiphar's wife as found in the Koran. Obliged again to flee, he sought refuge ultimately with the governor of Kohistan. The latter made efforts for a reconciliation between the wronged poet and the angry sultan, and not without success. Firdausī, however, had meanwhile returned to his old home in Tūs. Thither Mahmūd sent to him, it is said, the once-promised gold pieces, together with a robe of honor, and a handsome apology. The reconciliation came too late. The aged poet had just died, A. D. 1020 (A. H. 411) in his eightieth year, or some eleven years after the completion of his great work.

To the story is added a statement that the Sheikh of Tūs at first hesitated to grant Firdausī's body the proper funeral obsequies, on the ground that he was an infidel, and leaned toward the old faith of the fire-worshipers. Warned in a dream, however, the sheikh revoked the decree and Firdausī was honorably interred. The gift sent him by Mahmūd of Ghazni was ultimately accepted by the dead poet's relatives, and employed in carrying out the design, which in his lifetime he had cherished, of improving the dikes of Tūs.

Firdausī's *Shāh-Nāmah*, or Book of Kings, is one of the great epics of literature. It is really the national chronicle of Iran, narrating the achievements of the ancient kings from the mythical days of Kaiūmers, the first King of Persia, down to the Mohammedan conquest, A. D. 641. The most interesting portion of the poem is its first half or two-thirds, down to the invasion of Alexander. Though much of the material is legendary, fabulous, and romantic, Firdausī seems in general to have followed quite faithfully his sources referred to above; and in the poem there is unquestionably a vast store of real history. The *Shāh-Nāmah*, for example, has thrown much light on many historical allusions in the AVESTA (*q. v.*). The language of the *Shāh-Nāmah* is in general a pure Persian, comparatively free from Arabic elements; and the style is worthy of the subject and not overladen with an excess of Oriental richness and coloring. The nature of the poem, a sort of rhyming chronicle, precludes real epic unity; but the composition of the book is interesting as being the work of one person. Some of the best parts of the poem are the episodes. The most famous perhaps is that of Sohrab and Rustem.

The best editions of the text are by Turner Macan, *Shāh-Nāmah, an Heroic Poem* (4 vols., Calcutta, 1822–29); by Jules Mohl, *Le Livre des Rois* (6 vols., Paris, 1831–68); Vullers, *Schahname* (3 vols., Leyden, 1877—continued by Landauer). There is a complete French translation by J. Mohl, *Le Livre des Rois traduit et commenté* (7 vols., Paris, 1876–78); also an Italian one by Pizzi, *Firdusi, Il Libro dei Re* (8 vols., Turin, 1886–88), and an unfinished German translation by Ruckert, *Firdosis Königsbuch Schahname*, hrsg. von E. A. Bayer (Berlin, 1890). Selections in German are by A. F. von Shack, *Heldensagen des Firdusi* (3 vols., Stuttgart, 1877); and there is a convenient English translation and abridgment by James Atkinson, *Shāh-Nāmah*, (London, 1832), of which a handy reprint has been published (New York, 1886). Consult also Ouseley, *Persian Poets, Ferdusī* (London, 1846), and Görres, *Heldenbuch von Iran* (Berlin, 1820).

An edition of the *Yūsuf and Zuleikha*, of which an extremely rare manuscript is to be found in the British Museum, is being prepared by Ethé. Furthermore, regarding the genuineness of some minor poems attributed to Firdausī, consult Ethé in *Münchner Sitzungsber* (1872–73).

A. V. WILLIAMS JACKSON.

Fire: See FLAME and COMBUSTION.

Fire-alarms: devices used for giving notice of the occurrence of a fire, classified as fire-alarm telegraphs, automatic electric fire-detectors, and mechanical fire-detectors. In the first named a system of signal-boxes is distributed over a given district, and connects by electric circuits with a central station, and thence with a series of alarm-bells on a second circuit. By giving a signal at one of the boxes the place of the fire is telegraphed to the central station, and from the latter to the signal-bells at the local stations, to direct the engines to the place where needed. The first practical trial of a fire-alarm telegraph system was made in 1851 in Berlin and New York, but the plan was much modified in succeeding years, and as thus changed was fully adopted in some of the cities of the Eastern States before being put into regular use in New York in 1871. Although simple in principle, the details of the system are somewhat complex, and for a full description the reader is referred to the U. S. patent of Farmer and Channing, dated May 19, 1857. It is well known that different substances or mechanical devices change their volume or position with change of temperature; and if we imagine one of these substituted in lieu of human fingers to break or close, by such changes, an electric circuit connected with alarm mechanism, we have an idea of the essential principle of a self-acting electric fire-detector. Mechanical detectors depend for their action upon agencies altogether mechanical; such, for example, as the burning of a string to set the annunciating appliances in motion.

The fire-alarms of most interest are those of the automatic electric variety, of which in recent years a number have been devised. In each of these a thermostat, acting, when heated, by change of form or position, is used to break or close a circuit; but the arrangement of the circuit wires, the thermometric devices, and the accessory mechanism in the different plans are widely different.

The earliest record of an electric fire-alarm appears to be the British patent of N. Rutter (1847), in which the mercurial column of a thermometer closes the circuit when the temperature is high enough to be dangerous. A galvanometer, alarm-bell apparatus, and electro-magnetic coil are included in the circuit. Thermometers properly fitted with wires are placed in important parts of the building, so that any unusual increase of temperature becomes instantly known. On the completion of the circuit a soft iron bar, detached from a permanent magnet, falls upon the detent of a spring or other alarm, putting it into action, and at the same time deflects the galvanometer needle, so as to show the place of the danger. Rutter also proposed the modified use of his invention as a "burglar-alarm" and for the detection of undue pressure of steam in boilers, etc. In 1852 one John Hunter suggested applying fusible or combustible conductors to render electric telegraphs self-communicating in case of fires. In the same year Price patented a thermometric circuit-actuating device, the principle of which has been, and still is, in practical use. Lloyd describes an indicator for completing the circuit by means of a curved compound metallic strip made of steel and hammered zinc, connected with one battery pole; the other battery pole is fixed to the opposite part of the instrument. On elevation of temperature the strip straightens itself and completes the circuit. Lloyd describes an alarm in which a detent lever, actuated from the circuit, releases a toothed wheel, which is then rotated by a cord and weight, whereupon a suitable escapement causes a hammer to strike a bell. In 1857 Greenhow patented a valuable modification, in which, instead of setting the alarm in action by completing the circuit, the same effect is produced by breaking it.

In 1865 Charles Dion, of Montreal, Canada, patented in France fire-alarms embracing contrivances both electric and mechanical, and of simple and scientific construction. Other apparatus brought forward about the same time included the use of thermometric devices that under ordinary conditions themselves form a portion of the circuit, so that elevation of temperature will break the circuit and transmit the alarm, the same also occurring when the circuit is broken by accident. Some automatic fire-alarms have been so constructed that only one line-wire is required for any number of rooms in a building, and the signal-boxes of the ordinary alarm telegraph are retained. The thermometric devices or thermostats employed for initiating the action of the alarm mechanism are of various kinds, but are too numerous for detailed description here.

The ease and convenience with which electricity may now be applied tend to render merely mechanical fire-alarms obsolete, but there may be places where they may be employed to some advantage. There have been numerous plans for their employment.

Joseph Smith patented in Great Britain in 1802 a fire-alarm set in motion by the burning of a string. In another device for the same purpose all the apartments of a building were connected with a single one by means of tubes. It was expected that the occurrence of a fire in any apartment would send a current of air through the corresponding tube, and thus make it manifest. Still another device employed the rupture of a brass wire softened by mercury, brought into contact with it by expansion to start a train of wheels, and thus ring a bell. In what is known as Tunnicliffe's invention a small cylinder of gunpowder is furnished with a fuse igniting at 200° F., the device being hung to the ceiling of the room and the explosion sounding the alarm. In 1872 F. F. Herman combined with an alarm a gun-cotton cord connecting with the wick of a lamp, to light the latter when the alarm was started. In 1873 William A. Barnes patented an alleged improvement in alarm cartridges, acting on the same plan as Tunnicliffe's, but not so liable to fly into dangerous fragments when exploded. Also in 1873 Henry L. Brown patented a contrivance which the Patent Office brief describes as follows: "The detent lever of a wound-up alarm-bell mechanism is connected with the arm of an inflated bellows or air-chamber, which is in air-tight communication with a tube of fusible metal running through the rooms to be protected. On the melting of the closed tube by a fire at any point, the escape of air collapses the air-chamber and the alarm is sounded." This *modus operandi* is reversed in the contrivance patented in the same year by Charles H. Lehnis, consisting of one or more U-shaped tubes containing mercury, one arm being in connection with a closed and exhausted fusible tube extending to the locality to be guarded. In Dion's mechanical application of his funnel thermometric device the balanced lever was made hollow, and a sphere of some heavy substance was placed therein above or near the point. On the tilting of the lever by the upward movement of the funnel the ball rolled out against the detent of a bell-sounding device, and thence into the mouth of an inclined tube that conducted it to a receiver in the office of a hotel, for which class of buildings the apparatus was more especially designed, the balls being marked with the numbers of the rooms.

The subject of automatic fire-alarms has received much attention from inventors, and numerous improvements calculated to extend their application, or to remedy real or apparent defects, have been secured. In 1881 was patented an ingenious combined fire-alarm and gas-lighting mechanism. In the same year Peter H. Van der Weyde patented the combination "with a pneumatic fire-alarm tube of a plunger retained by a piece or plate of fusible alloy, which by its melting will cause the plunger to be propelled by a weight or spring and act upon a diaphragm bellows or on an air-pump, and operate the signal." In the same year another inventor patented an apparatus in which the alarm is given by a horn or trumpet adapted to be operated by a blast of air, this used in connection with a source of supply of compressed air, a suitable valve, and means for operating the device from a distance. In 1892 twenty-four patents relating to fire-alarms were issued in the U. S. Among the patents hitherto issued have been combined electric fire-alarms and call-bells, combined fire-alarms and extinguishers, combined fire and burglar alarms, a combined fire-alarm and time-detector, combined fire and police alarms, a combined fire and telephone telegraph system, and an apparatus for testing fire-alarms and an apparatus for preventing false alarms. The patents of course include fire-alarm devices of the several classes already designated, and comprise a wide variety in structure and method of operation. One of the inventions in this field (patented Aug. 8, 1893) comprises the combination with the gas pipes containing illuminating gas in a building of—with other mechanism—pressure-inducing devices, which are normally inert until heated in such a manner that the gas becomes the medium for actuating the alarm by transmission of impulses imparted by such devices.

The importance of automatic fire-alarm apparatus is but beginning to be adequately appreciated. Contrivances operating on similar principles are capable of being successfully applied to many other purposes; as, for example, the detection of "heating" in grain-bins, and for the maintenance of desired temperature in various industrial operations.
JAMES A. WHITNEY.

Fire-armor: appliances designed to protect the respiratory organs against smoke, heat, gases, etc. The idea of fire-armor was naturally derived from that of submarine armor, and the first apparatus of the kind was adapted for either use. The U. S. patent of W. H. James, granted in 1828, describes a diving-dress which the inventor stated could be employed "in mines and other places filled with deleterious gases, wherein it may be used with perfect safety and very great advantage." In this apparatus air was supplied from a receiver placed around the waist to a helmet which inclosed the face of the wearer. Suitable devices were provided by conducting the air to the mouth and for preventing too great pressure from the air compressed in the receiver. It was calculated that an apparatus within a manageable compass could be made to hold air enough to last one hour, but to do this a pressure of 15 atmospheres, or about 225 lb. to the sq. inch, was required. This, together with the somewhat cumbrous character of the apparatus, seems to have led to its abandonment. The simpler apparatus of M. Galibert (see p. 344 of Dr. Barnard's *Rep. Paris Exp.*, 1867) has an air-receiver of india-rubber cloth, from which the air passes by a tube to the mouth of the wearer, the expired air passing out through a valvular device attached to the nostrils. A somewhat similar appliance has been used in England, the air being in this case contained in a sheet-metal cylinder strapped to the back like a fire-extinguisher.


Eye and lung protector.

After the James device just described a British miner named Roberts designed a "hood and mouthpiece," which attracted considerable attention, and, as a writer of that time avers, "its efficacy was repeatedly proved in the presence of numerous scientific individuals, amid the most dense smoke arising from the combustion of wool, wet hay, straw, shavings, and large quantities of sulphur, in temperatures varying from 90° to 240° F." It differed somewhat in details of construction from those that had preceded it, but involved no material change of principle in its operation.

One apparatus brought out in New York city in 1873–74 was termed an "eye and lung protector," and comprised a mask of novel construction held over the face by an elastic band passing about the head. A duplex shell, formed of thin steel covered with india-rubber, fits over the eyes of the person using the device; the external edges of the rubber being flexible, and so shaped as to fit tight around the eyes to exclude dust, smoke, etc., from the eyes: while the eyeholes provided in the shell have flexible lips, with a groove between, which receive plates of transparent mica, a tight joint being formed between the mica and the rubber. Provision is thus made for the protection of the eyes, independent of the respiratory organs. To protect the latter the duplex shell is provided with a curtain of porous cloth, which, being gathered in at the bottom by means of a string around the neck of the wearer, forms a semi-elastic bag over the lower portion of the face. In this is placed a wet sponge of suitable size and shape, held by the bag against the mouth and nostrils. The wearer breathes through the moist sponge, which eliminates from the air passing through it the dust, noxious gases, foul odors, etc., with which it may be impregnated, and also cools the air during such passage. This contrivance has been used on several occasions very effectively.

In San Francisco, on July 28, 1874, a small room was filled with smoke of "pulo" and tobacco until daylight could not be seen through the glass doors; four men provided with the "protector" remained in this atmosphere during more than half an hour without inconvenience. On Aug. 6, 1874, at a trial at Toronto, Canada, persons remained for twenty-three minutes in an atmosphere of smoke from damp straw and tobacco-stalks, in which the chief of the city fire brigade found it impossible to remain more than one minute without the protector. The necessity of wetting the air-filtering material on each occasion when desired for use could perhaps be obviated by some hygroscopic treatment of the sponge; for this purpose glycerin or some other neutral absorbent of moisture probably would prove efficacious.

A dust-muzzle or respirator is used where grain handled in large quantities in loading vessels from elevators or warehouses gives off clouds of almost impalpable dust. It comprises a metallic chamber shaped at its inner end to fit the mouth and nostrils and with its outer end provided with perforations which admit the air, and from which it passes to the respiratory organs through a filtering material placed within the chamber. The device is held in place when in use by a band which passes over the head of the wearer. The addition of a covering for the upper part of the face would make this device a cheap and simple fire-mask.

In 1888 an improvement in supplying a fireman's mask with fresh air comprised an air-pipe carried along the hose of the engine to the fireman holding the hose-nozzle. In another apparatus, patented in 1889, provision is made for breathing at will direct from the atmosphere, or through a suitable filter, or from an air-supply pipe suitably arranged. Another, made public in 1893, contemplates an armor to be worn by a fireman, the armor supplied with air and having external pipes, each provided with a mask capable of being placed over the head of a person in a suffocating condition to renew respiration during transport to a place of safety.

JAMES A. WHITNEY.

Firearms: arms loading with powder and ball; all arms which expel their charge by the combustion of powder, whether cannon, such as guns, howitzers, mortars, or small-arms, such as muskets, rifles, pistols, and fowling-pieces. See ARTILLERY, CANNON, and SMALL-ARMS.

Fire-brick: brick made from very refractory clay and used for the lining of furnaces, stoves, grates, etc. As they are largely consumed in iron-making, the manufacture is an important branch of industry which has been carefully perfected by experience, and is now largely carried on at certain localities where the somewhat rare materials used for the purpose are most easily attainable. Fire-brick are usually made from FIRE-CLAY (*q. v.*), but other materials are used in their manufacture; as, for example, the "Dinas brick," the fire-brick most esteemed in Wales, is made of pulverized quartzose rock cemented with a little lime. In the U. S. the best fire-brick are made from the "Amboy clay" (a cretaceous clay found in New Jersey) and from the fire-clays of the coal measures of Pennsylvania, Ohio, Illinois, and Missouri. In the manufacture of fire-brick both plastic and non-plastic clays are employed. In the use of a plastic clay like that of New Jersey this is first burned in a kiln, losing its plasticity by the process, and becoming what is known as "cement." This is then coarsely ground, mixed with from one-sixth to one-tenth of plastic clay, molded, and burned. The Mt. Savage fire-brick are made at Mt. Savage, Md., from two varieties of carboniferous fire-clay; one of which is non-plastic, in its natural state has the properties of the "cement" before mentioned, and is treated in the same way. The Mt. Savage brick are of great excellence—being equally esteemed with the Amboy brick—and are extensively used throughout the U. S. At Mineral Point, Tuscarawas co., O., a non-plastic clay is found similar in appearance and properties to that used at Mt. Savage. It is here manufactured in the same way, and the brick made from it are scarcely inferior to those before mentioned. In all factories of fire-brick the refuse of the kilns is ground over and cemented with a little fresh plastic clay, and in this way brick are manufactured which have great power to resist fire. From their mode of manufacture the most refractory fire-brick are necessarily tender and have little power to resist mechanical strain or violence. They are therefore employed only for the central portions of furnaces, where they are exposed to the greatest heat. Higher up in the blast furnace and near the doors of puddling furnaces brick of greater strength and less resistance to fire are used. These are made in large part of plastic clay, to which more or less sand is added. In the various parts of the different kinds of furnaces used in smelting operations brick of different shapes and qualities are required; hence at all factories may be seen bricks of various forms and sizes, and those in which the materials are differently mixed. As all iron furnaces frequently require to be relined with fire-brick, the impression generally prevails that they are rapidly destroyed by the action of the heat. This, however, is not true, as the best fire-brick are infusible by ordinary means. The rapid destruction of fire-brick which takes place in a furnace is for the most part due to the union of the iron with the silica of the brick, forming a fusible slag; in this way the brick are eaten or dissolved away. In the selection of clay for fire-brick it is important that it should contain as little iron, lime, soda, potash, etc., as possible, as these readily combine with the silica, forming fusible silicates. The price of the best fire-brick in the U. S. varies from $35 to $60 per 1,000 at the kiln, and these are made at comparatively few localities. Cheaper brick, and those of somewhat inferior quality and yet adapted to most purposes for which fire-brick are used, are or may be manufactured at a thousand different localities; wherever, indeed, a reasonably good fire-clay can be obtained. See BRICK.

J. S. NEWBERRY.

Fire-clay: the name specifically applied to the beds of clay which underlie most of the coal-seams in the Carboniferous strata. They are so called because as a class they are very resistant to the action of fire. These clay-beds are fine sediments which accumulated at the bottom of shallow pools of water, subsequently filled up by growing vegetation. The roots of aquatic plants penetrating this clay have generally abstracted its potash, soda, lime, iron, etc., and have removed such a percentage of silica as to leave it with a larger relative quantity of alumina than it had before being subjected to their action. Thus they have taken from it its more fusible ingredients, and have imparted to it the peculiar property it possesses of remaining unchanged at a high heat. Clays very like fire-clays are found underlying many beds of peat, and in such circumstances the formation of fire-clay may be seen going on.

In the U. S. there are two varieties of fire-clay—the one non-plastic, and specially adapted to the manufacture of fire-brick; and the other plastic, and used also for fire-brick, and for pottery, glass-pots, etc. In the first class are the clays of Mt. Savage, Md., Mineral Point and New Lisbon, O., and from these large quantities of superior fire-brick are made. The second class includes most of the fire-clays of the coal measures. These differ much among themselves as regards purity and excellence, but they are very largely employed for the manufacture of stoneware and second-quality fire-brick. Analyses are given below of some of the best and best-known fire-clays, Nos. 2 and 3 being non-plastic and Nos. 4 and 5 plastic clays:

ANALYSES OF FIRE-CLAYS.

SUBSTANCES.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.
Water	17·34	12·74	11·70	5·34	5·45
Silica	45·25	50·45	49·20	59·95	70·70
Alumina	28·77	35·90	37·80	33·85	21·70
Oxide of iron	7·72	1·50			
Lime	0·47	0·13	0·40	2·05	0·40
Magnesia	....	0·20	0·10	0·55	0·37
Potash					

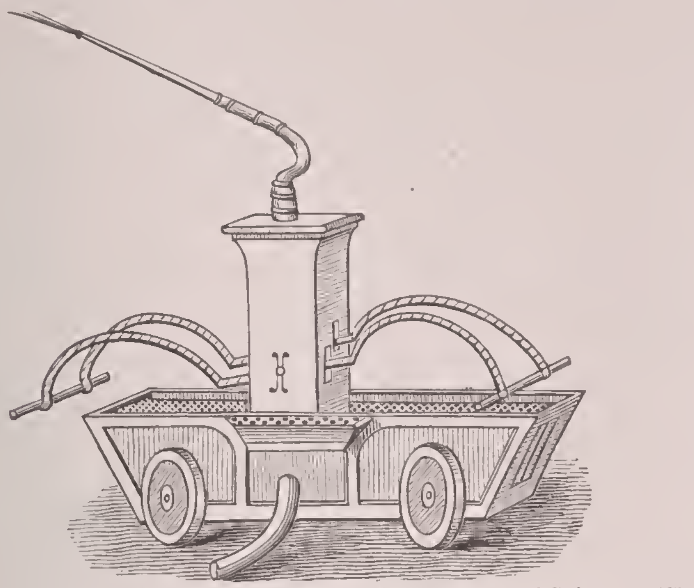
No. 1 is from Stourbridge, England; 2, Mt. Savage, Md.; 3, Mineral Point, O.; 4, Port Washington, O.; 5, Springfield, O.

J. S. NEWBERRY.

Fire-damp: See MARSH-GAS.

Fire-eater: a term the invention of which is ascribed to Col. Howell Rose, of Coosa co., Ala., who in the Southern Rights convention at Montgomery co., Ala., in 1851, applied this epithet to the avowed Disunionists of that body. The term was afterward applied in political parlance to extremists among the Southern Rights men, whether Disunionists or not.

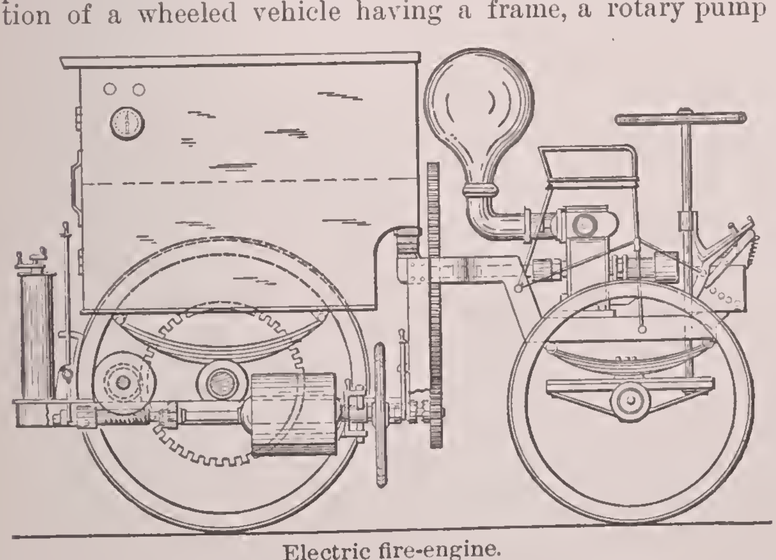
Fire-engines: machines for extinguishing fire. The earliest fire-engines were huge squirts or syringes mounted upon wheels. These are known to have been used in Augsburg as early as 1618. The transition from the squirt to the pump on wheels initiated the fire-engine. The improvement of the pump was a matter easily reached, but by slow stages, and by the middle of the eighteenth century the fire-engine embodied a practically valuable, though mechanically crude, machine, such as is shown in the Newsham engine. Two of these were taken to New York in 1732, and were doubtless the first in use in the U. S. Floating fire-engines with rotary pumps were in use in England before the close of the eighteenth century. Floating steam fire-engines were proposed by an English writer in 1834, and in


Newsham's fire-engine. From a dictionary of Arts and Sciences, 1754.

1850 a pump was placed upon a propeller and geared with the engine. It threw 600 gal. per minute to a height greater than any of the buildings on the East India Docks, London. The utility of steam-power for the purpose in land engines had been demonstrated eleven years before by Braithwaite and Ericsson, but these engines met with less favor than they deserved. The first steam fire-engines in the U. S. were made in 1840, although the earliest American patent on improvements was that of A. B. Latta, of Cincinnati, O., May 22, 1855. Self-propelling steam fire-engines have been constructed at various times, but thus far experience has approved the use of horses for the transfer of engines from place to place in the exigencies of practical use.

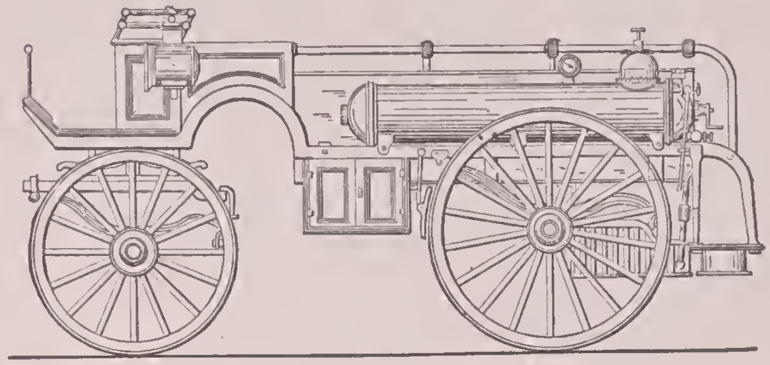
The improvement of manually operated fire-engines had, however, early attracted attention in the U. S. The earliest American patents relating to the art were those of J. Kersey, Apr. 13, 1797; S. E. Hamlin, Aug. 30, 1799; and S. E. Steward, Dec. 6, 1803. With the destruction of the Patent Office by fire in 1836 knowledge of the structure or character of the inventions of these patentees perished, and a like remark applies to the improvements covered by patents, of which there was one in 1807, three in 1812, one in 1813, and others in subsequent years. Successive improvements, fitting the machine for all the vicissitudes of use in large cities, have made the steam fire-engines used in the U. S. the best examples of their class in the world.

The great development of electricity as applied to the arts has led to its proposed use for the propulsion of fire-engines. The accompanying cut illustrates an engine embracing the principle indicated. It was patented Dec., 1891. It comprises in its construction among other things the "combination of a wheeled vehicle having a frame, a rotary pump


Electric fire-engine.

fixed upon the front part of the frame and having its driving-shaft extending lengthwise of the vehicle, an electric motor supported upon the vehicle nearer the rear axle, means to connect said motor either with the wheels of the vehicle to propel the same or with the pump, as desired," the engine being thus self-propelling and the motor used for propulsion serving also to throw the water-jet through the hose.

Another invention, patented on the same date, relates to chemical fire-engines so called (see FIRE-EXTINGUISHERS), and has for its object due provision for carrying hose, so as


Combined chemical fire-engine and hose cart.

to dispense with a separate hose-wagon, and also the convenient placing and support of the tanks which contain the extinguishing agents. The hose for the chemical tanks is carried in the depressed baskets suspended at the rear. The chemical tanks are of cylindrical form and are placed longitudinally one at each side of the frame, and between them is a receptacle for the desired quantity of water-hose.

JAMES A. WHITNEY.

Fire-escapes: devices to facilitate the escape of persons from burning buildings. The common fire-escape is simply a system of fixed iron ladders attached to a building to permit descent from the upper windows, ordinarily with a platform or balcony provided for each story. Scores of complex machines intended for use as fire-escapes have been projected, but reliance is still had by firemen upon sectional ladders manipulated at a great disadvantage by hand. These were in use previous to A. D. 385, as also were flexible ladders with hooks at the ends, which were thrown to catch upon walls and window-sills. Telescopic tubes raised perpendicularly from a base-frame by means of a screw, and carrying a basket large enough to hold several persons, also lazy-tongs, or jointed superposed bars lifting a platform, were also known at that date. Both of these principles of operation are embraced in numerous fire-escape apparatus projected in recent times.

Apart from fixed ladders attached to the building, and the sectional ladders of the hook-and-ladder companies, fire-escapes may be classified as of six varieties. Of the first class, one of the most efficient was brought forward about the middle of the nineteenth century and was known as the "sling" fire-escape. It comprised a rope passed over a sheave temporarily hooked to the window-sill, the rope being furnished at one end with a sling or loop serving the purpose of a seat, and also with a belt passing around the waist; the opposite portion of the rope being grasped by the hand, and slowly paid out until the person was let gently to the ground. The same principle has been reapplied with various additions and modifications. In the second class a number of ladders lie flat upon a vehicle during transport from place to place, and when required for use are lifted to a nearly vertical position, and then moved out longitudinally, one from the other, until their utmost limit is reached. In the third class the apparatus comprises a strong sail-cloth tube distended by a hoop at the upper end, attached to a window, the diameter of the tube being such that a person sliding down could regulate his speed by passing his elbows outward against the sides. The tube should be stretched from the window to the front at an angle of 45°. That it provides for the safe descent of persons from a great height without danger has been often demonstrated by experimental trials; among others, by one in the neighborhood of the city hall in New York in 1869. Another apparatus is constructed with a telescopic tube to be elevated from the sidewalk, and formed at its lower end with a curved outlet to gradually check the rapidity of the descent. The fourth or lazy-tong system is open to the apparent objection of being somewhat complicated, but its practical operation dates from the fourth century, when the plan was employed for raising soldiers to the tops of walls. The "lazy-tongs" have been actuated by various combinations of screws, gearing, etc. A tolerably efficient device of the fifth class was proposed, and to a slight extent adopted, in England in the beginning of the nineteenth century. It consisted of a strong pole of from 36 to 40 feet in length, surmounted by an iron cross-bar designed to rest against the side of the building and to keep the pole from turning. About 3 feet from its upper extremity the pole carried a pulley, over which was a rope having at one end a basket, the rope being worked from the pavement to raise and lower the basket. The rope, pulley, and basket have been frequently combined with a ladder, the last taking the place of the pole previously described. The most useful example of the sixth class is the fire-escape of Ranald Macdonald, of Brooklyn, N. Y., in which thin wire ropes are joined by rounds formed of gas-pipe, thus forming a flexible ladder which is wound on a portable reel when not in use, but which may be readily extended from an upper window in case of emergency.

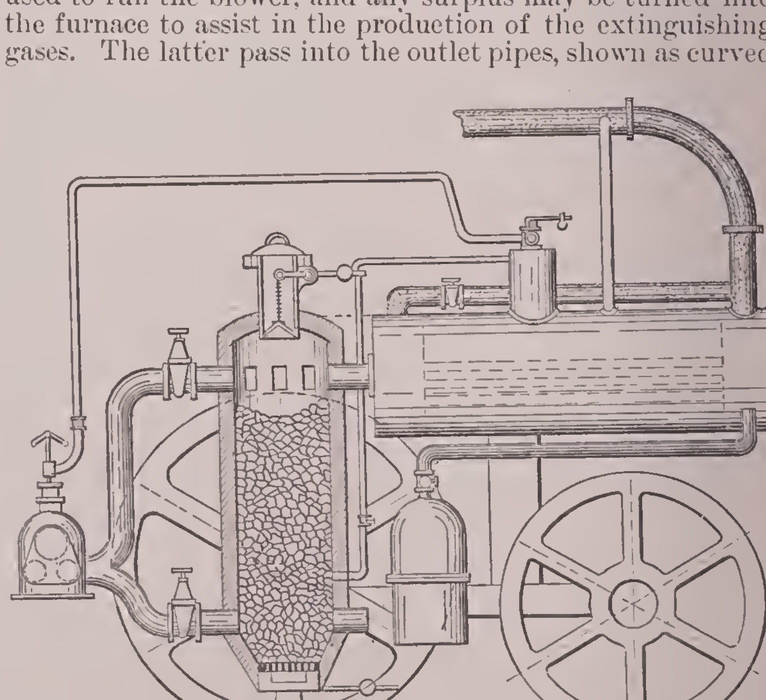
A fire-escape apparatus preferably should be a fixture of the building and so arranged as to permit the rescue of persons from the dwelling as well as to permit their voluntary escape. An apparatus invented by Dr. Abraham W. Lozier, of New York city, and patented in 1884, has been carefully designed to meet these conditions. A fixed ladder is surrounded by a protecting case which can be opened from the street, an alarm being automatically sounded within the building when the case is thus opened. It may also be opened from within to afford access to the ladder to the occupants of the building, the ladder being arranged in convenient relation with a window platform. Interest in the subject appears to be greatly on the increase with inventors. During the years 1888–1892 inclusive no less than 333 U. S. patents were granted on fire-escapes. JAMES A. WHITNEY.

Fire-extinguishers: apparatus for extinguishing fires either by means of water or by non-combustible gases. The term technically considered excludes fire-engines, although the principle of operation may be similar in both.

The original fire-extinguisher, in the sense in which the term is now generally used and understood, was the invention of William A. Graham, of Lexington, Va., who filed his applications for a patent in Nov., 1837. The patent was issued more than forty years later, in July, 1878, and its validity was sustained in a Federal decision six years after. Among other things Graham claimed as his invention "the method of extinguishing fires by means of a properly directed stream of mingled carbonic acid gas and water projected by the pressure or expansive force of the mingled mass from which the stream is derived"; also "the combination of fixed pipes or tubes arranged by or through a building with a stationary or fixed fountain or tank, for forcing mingled carbonic acid gas and water by its own elasticity through said pipes"; also "the combination of a strong vessel for containing the mixture of carbonic acid gas and water under pressure, with a stop-cock, flexible hose-tube, and a nozzle." The carbonic acid gas was compressed in the liquid either by artificial pressure or by generation therein. Graham claimed to be the discoverer of the fact that "carbonic acid gas compressed in water in the proportion of ten or more volumes of gas to one of water, in portable fountains or fixed reservoirs, could be usefully applied to extinguishing fires"; and that he had "devised suitable apparatus by which a stream of gaseous water, by the elastic force of the gas, would be projected a distance of 40 feet, so as to quickly, cheaply, and effectually subdue the fire." Graham died in 1857 after twenty years of vain endeavor to convince the Patent Office of the patentability of his invention. Twelve years later certain foreign inventors, who probably had no knowledge of Graham's invention, received a U. S. patent embracing its principle, but were unable to carry back the date of their discovery of it beyond 1861, whereas it was shown that Graham, aside from his application for a patent in 1837, had successfully made and used an apparatus embodying the discovery as early as 1853. This appeared in long subsequent litigation. In 1876 the administrators of Graham filed a new application for a patent, which was rejected on the ground of delay and long public use. On June 14, 1878, an act of Congress was passed which revised the original application of forty-one years before, and upon this the patent was finally issued. Drawings which accompany his patent specification show the mechanical structure of the apparatus to have been somewhat crude, but Graham appears to have been beyond question the originator of that class of fire-extinguishers which depend for their operation upon the combined use under pressure of carbonic acid and water. In 1851 what was known as the Philips fire "annihilator" was tested with experimental success. Its operation depended upon the chemical evolution of certain non-combustible gases in connection with the vapor of water.

Among the various modifications of, and practical improvements upon, the Graham extinguisher was the employment in 1867 of a sealed glass vessel to hold the acid, which is fractured on occasion by suitable mechanical devices; also the use (in 1870) of one or more perforated plates, partitions, or diaphragms arranged within a portable fire-extinguisher and below the acid vessel, to distribute the acid through the alkaline solution previously provided therein, to facilitate the chemical action, and to prevent the accumulation of the acid at the bottom of the vessel. Previous to this, in 1868, an apparatus was made that when used was inverted, having the effect of mixing dry acid on a foraminous internal shelf with the water already charged with the opposite material, thus producing and charging the water with carbonic acid gas, which, upon the opening of the cock, forcibly discharged the water from the vessel." In an apparatus patented in 1888 a charge of peculiar composition is placed in the upper part of the closed chamber containing the liquid, and being ignited produces a gas which, accumulating until a high pressure was reached, remains to exert a constant pressure upon the water. The apparatus is kept continually under pressure, and in this respect acts mechanically, upon the same principle as that of the first fire-extinguisher ever made, the compressed gas in the one case being simply an equivalent for the compressed air in the other. The Babcock extinguisher is filled with a solution of bicarbonate of soda, and has in its upper part a vessel of acid suspended by lateral pivots to a stirrup depending from the top of the apparatus. The stopper of this vessel is worked by a rod through the top of the extinguisher. By withdrawing the stopper the vessel tilts over, and mingles the acid with the solution, thereby discharging the carbonic acid from the latter. An improved method of generating gas in fire-extinguishers, patented in 1890, consists in first mixing hydric sulphate with a solution of sulphite of soda or other sulphite, and then throwing the mixture into a solution of a carbonate contained in the main vessel of the extinguisher.

As carbonic acid at ordinary temperatures is heavier than air, and much heavier than air heated by conflagration, it has been contended that the extinguishing agent tends to descend through the burning material before fully accomplishing its purpose. To meet this difficulty an elaborate apparatus operating with heated extinguishing gases was patented in 1888. In this a furnace is so combined with a blower and air-conducting pipe that air for the combustion of the fuel is found below the latter to provide for its conversion into carbonic oxide, and above the fuel to convert this oxide into carbonic acid. The latter passes into the flues of a steam-boiler, shown horizontally at the right of the figure, and generates steam in the boiler. The steam is used to run the blower, and any surplus may be turned into the furnace to assist in the production of the extinguishing gases. The latter pass into the outlet pipes, shown as curved

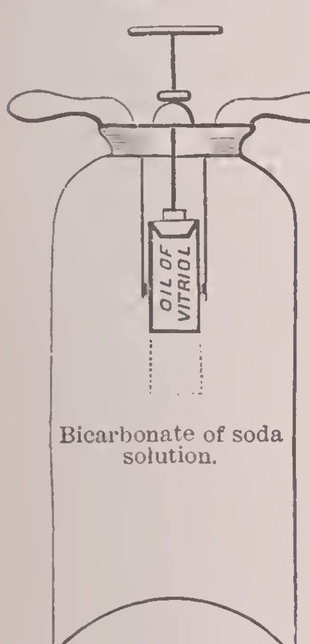


Fire-extinguisher using hot gases.

in the figure, from which they are passed to the fire to be subdued. A supplemental carbonic acid reservoir is so arranged that its contents may pass to and mingle with the extinguishing gases from the furnace, there being sufficient heat to expand the carbonic acid to the requisite relative degree of lightness. The apparatus is intended to be supported upon a suitable wheeled frame, so as to be readily transported from place to place.

Numerous accidents have occurred on railways resulting in the burning of the wrecked cars from fire communicated from the heating stoves. To provide against this various plans for automatically extinguishing the fire in the stove in the event of derailment or collision have been devised. In one of these, patented in 1888, a reservoir filled with water or other extinguishing agent is so suspended that it retains its normal vertical position when its supporting frame or casing is tilted. In the upsetting or wreck of a car the change from a vertical to an inclined position on the part of the frame produces a corresponding change in the relative positions of the reservoir and the casing. This, through suitable mechanism, is caused to actuate a valve which opens the reservoir, and through a suitable connecting pipe causes the water or other extinguishing material to be directed into the fire-box of the stove to extinguish the fire therein.

The transition from a fire-extinguisher small enough to be carried on the back to one sufficiently large to require wheels was easy and natural, and under the name of chemical fire-engines these latter have been put in practice, with a measure of success. Among the alleged improvements is one (1869) in which there is arranged upon a truck or carriage "two or more cylinders or reservoirs, connected by pipes which are controlled by stop-cocks, and which connect with an issue-pipe or nozzle common to all the pipes, so that in extinguishing a fire one reservoir may be re-supplied while another is being exhausted, and thus a continuous supply and stream be kept up and thrown upon the fire." Another apparatus, produced a year or two previous, was constructed with a chamber, in the upper part of which was placed the gas-generating material, determinate portions of this latter being brought automatically from the chamber and mingled with the stream of water ejected by a forcing pump. In another a stream of carbonic acid gas from a separate receptacle was caused to mingle with the jet issuing from an ordinary fire-engine. Grenades or bombs, so called, filled with suitable fire-extinguishing substances and designed to be thrown by the hand, and to fracture on falling in the fire, have been made, and are claimed to operate with success.



Babcock's fire-extinguisher.

Numerous methods have been proposed for insuring the automatic action of fire-extinguishing apparatus through the inevitable increase of temperature. Pipes extending from a central reservoir charged with water or extinguishing gases, and provided with fusible plugs or actuated by a thermostat, have been largely and successfully introduced of late years. JAMES A. WHITNEY.

Fireflies: nocturnally luminous coleopterous insects of the families *Lampyridæ* and *Elateridæ*, the former including the glowworms. According to some writers, some of the *Fulgoridæ*, which are hemipterous insects, are luminous also, but the weight of the evidence is quite to the contrary. The luminous organs of fireflies and glowworms are composed of yellow masses of cells filled with granular matter and traversed by many tracheæ. It is now generally held that the light is produced by the slow combustion of granular and perhaps fatty matter, oxygen being abundantly supplied by the tracheæ. Phosphorus does not appear to be present in any noteworthy amount in the luminous matter. Spectroscopic examination of the light of insects of both families gives a very beautiful continuous spectrum without lines. The fireflies of Central and South America are chiefly *Elateridæ* of the genus *Pyrophorus*. They generally give a very intense light, which comes from two spots on the prothorax. The U. S. have some *Elateridæ* with luminous larvæ (*Melanectes*). The common "lightning-bugs" of the U. S. are of numerous species, all *Lampyridæ*, and mostly of the genera *Photinus* and *Photuris*. *Photuris pennsylvanica* is the most common. Both sexes are winged. *Photinus* is distinguished from the old genus *Lampyris* by the females being winged. See GLOWWORM.

Fire-hole River: a river of Wyoming; the main fork of Madison river; flows from Madison Lake, a sheet of water of some 60 acres area, N. W. through the Fire-hole Basin, one of the most remarkable geyser regions of the National Park. See YELLOWSTONE NATIONAL PARK.

Fire Island Beach: a low, sandy spit of land broken by a few inlets; separates the Great South Bay of Long Island from the Atlantic. It is some 30 miles in length, and belongs to the township of Brookhaven, Suffolk co., N. Y. At its western extremity is Fire island inlet and a lighthouse of brick 166 feet high, with a flashing light of the first order; lat. 40° 37′ 54″ N., lon. 73° 12′ 48″ W.

Fire-insurance: a form of business enterprise in which for a consideration called a premium, and under suitable conditions, compensation to a specified extent is guaranteed to property-holders for loss arising from fire. Like other kinds of insurance, it is the bearing of the losses of the few by the contributions of the many. If this is done simply by and among the members of an organization the plan is called mutual; if it is done by a corporation issuing its policies to applicants who pay an agreed premium and shift the hazard over upon the company it is called joint stock. The practice of fire-insurance is modern. Marine insurance preceded fire by at least two centuries, and apparently it was not until 1609 that fire-insurance was established, when a scheme was suggested in Germany for insuring the houses of subjects by the Government. Count Anthony von Oldenburgh, to whom the plan was presented, admitted its merit, but feared if he engaged in it that Providence might be tempted, his people displeased, and himself accused of avarice. As Walford, the historian of insurance, remarks, "but for this superstitious fear the Germans might have claimed the credit of laying the foundation of the present system of fire-insurance." There does not appear to be any public record of definite action in regard to fire-insurance until the year 1681, when on Oct. 15 an English insurance fund was formed by act of the corporation of London; but the first regular fire-insurance office was not started until 1696, thirty years after the great London fire. The name of the company was the Amicable Contribution. This name was changed in 1718 to the Hand-in-Hand. This was a mutual company and is still in existence. Thus fire-insurance existed in England for seventy years before it first developed in organized form in North America. To some extent it was practiced through agencies or individuals prior to 1752; but on Apr. 13 in that year the subscribers to the first American insurance scheme met in the court-house in Philadelphia and elected twelve directors, Benjamin Franklin's name standing at the head of the list. This was the Philadelphia Contributionship, and the company is still extant. From this small beginning has grown a volume of business as startling in its magnitude as it is important and beneficent in its reach. The amount covered in 1893 by fire-insurance in the U. S. is approximately ten times as great as was the entire property valuation of the country when the first company was organized, the fire-policies extant covering $24,000,000,000! Early figures are not available, but the more recent development of fire-insurance in the U. S. is indicated by the following table:

YEARS.	Property valuations in the U. S.	Amounts insured.	Percentages insured.
1860	$16,159,616,068	$1,681,255,609	10·41
1870	30,068,518,507	5,044,884,495	16·78
1880	43,642,000,000	9,132,162,479	20·90
1890	62,610,000,000	19,091,231,250	30·41

Thus in thirty years fire-insurance in the U. S. multiplied more than eleven times, while property multiplied less than four times. The *amount* of the increase is not so very astonishing when it is remembered that every industry in the U. S. enlarges phenomenally, but the *ratio* of increase or the values to be insured is illustrative of the vigor and industry with which the business has been prosecuted. If one-half of the above valuations represents land and other incombustible properties or improvements, then two-thirds of the burnable property of the U. S. is protected by insurance, a fact which throws an important light on the business possibilities of the present era through the protection of credits and the enlargement of enterprises which would be impracticable but for the re-enforcement which insurance affords. This is of universal application wherever insurance is generally practiced.

According to the best information obtainable there are (1893) over 600 companies prosecuting fire-insurance in the U. S., as follows:

U. S. joint-stock fire-insurance companies	338
U. S. mutual fire-insurance companies	212
U. S. marine insurance companies	14
Foreign marine insurance companies	12
Foreign fire-insurance companies	41
Total	617

The marine companies do but little fire-insurance, and the mutuals (except the factory mutuals) confine their operations mainly to the insurance of farm and village risks. The great bulk of the business is covered by those known as the "agency companies"—the domestic joint-stock and the foreign fire companies.

The Agency System.—When offices were few and confined mainly to the seaboard, inland towns and cities were without facilities for insurance except as they were obtained through correspondence. Gradually agencies were planted in the hands of merchants and bankers, but the rapid spread of the business, as tabulated above, soon drew to it men who made insurance their vocation, and in due time the entire country became covered with a network of agencies, until there are not less than 50,000 persons now engaged in the various branches of the agency business in the U. S. Some of the larger companies employ 3,000 agents each, and many of them 500 or more. The local agent, a resident of the town where domiciled, is a sort of resident autocrat. In the larger places he employs solicitors and sub-agents, and has an office with clerks and assistants. Next to the local agent comes the special agent. He is a trusted representative of the company, selected for his knowledge of the country and his professional skill. He establishes new agencies, stimulates old ones, and supervises the business generally in his district. Next to and above the special is the manager. Most of the agency companies sustain at least four departments—Eastern, Western, Southern, and Pacific coast—and often more, and over each of these a manager is appointed who is an experienced underwriter and competent to oversee several States, occupied perhaps by several hundred local agents.

The adjuster is an important figure on the company's staff. There are in the U. S. between 20,000 and 25,000 fires annually, large and small, involving an insurance loss each year of from $60,000,000 to $70,000,000. The settlement of these losses has called into existence a profession of great importance, and the adjusters are, as a rule, not only professional experts in their particular line but men of more than ordinary sagacity, business knowledge, and general ability. The incentives to fraud growing out of the easy obtaining of large lines of insurance and the comparative ease with which the crime of arson may be concealed have led to numerous incendiary fires, and the companies have been compelled to defend themselves by the employment of sharp adjusters, the offering of rewards for the detection of incendiaries, the use of bureaus for the interchange of reports concerning dishonest men, the employment of detectives, and other means of a similar nature. All these expenses, which add materially to the cost of insurance, grow out of what is familiarly known as

Moral Hazard.—There are two hazards in an insurance risk, the physical and the moral, both of which are prominently considered in determining upon its acceptance or rejection. The physical hazard includes the natural causes of fire, the combustibility of the risk itself growing out of its construction, occupancy, and exposure to other risks. For all this class of hazards reasonable estimates of the proper premium to be charged can be made; but for the moral hazard, which includes the dishonesty of owners and employees, the jealousy of rivals, the revenge of enemies, and all like causes, no price can be named, and where a risk is known or suspected to be tainted in this regard it is promptly declined by intelligent underwriters. In 1891 there were in the U. S. 2,602 fires attributed to incendiarism, with 1,956 exposed risks burned by the incendiary fires. These 4,558 cases involved an aggregate loss of $15,020,747, with insurances of $8,348,157.

Factory Mutuals.—What is known as the factory mutual system originated in Rhode Island about 1840, and grew out of dissatisfaction with the high rates charged for textile factories and other manufacturing risks which were regarded as excessively hazardous. A mutual insurance company was organized, which was soon followed by others in Rhode Island and Massachusetts. The prime object of these organizations has been not so much the payment of losses as the prevention of losses. To this end buildings accepted must come up to a certain standard, popularly known as "Mill Construction and Sprinkler Equipment." While these companies are important factors in the region where they work and among the classes of risks which they cover, their operations are necessarily very limited as compared with the whole field of fire-insurance. The total risks now covered by them do not exceed $650,000,000, mainly within the area of New England and the Middle States. Efforts have been made in the Western States to establish factory mutuals, but the frequency of manufacturing risks and the organized effort prevailing in New England being absent, these efforts have not been to any considerable extent successful.

Fire-insurance Lloyds.—A recent phase of fire-insurance in the U. S. is the "Lloyds plan," so called. It differs from the marine practice of individual underwriting, so familiar in Great Britain, and is partly the outgrowth of an existing dearth of large insurances and partly of a desire to avoid the onerous taxation laid upon corporations. Subscribers, usually a hundred or more, contribute a sum of $1,000 to $5,000 each, and appoint a representative whom they designate as an attorney. This person is an insurance expert, and he manages the business much as an ordinary executive of a regular company would do.

Individual underwriters are very much the same as the Lloyds, except that they insure only for members. Each member subscribes $2,000 or more, and his liability on each other member's policy is *pro rata* with the several subscriptions. All these schemes are modifications of mutual plans. The last two mentioned are quite modern, and like other insurance projects will prove their fitness as they are tested by time and fire.

Insurance Legislation.—Insurance being a business of a beneficent nature whose function is to sustain the credit of the merchant, manufacturer, and shipper, and add to the business stability of the state, it would seem as if it ought to be approached with more than usual intelligence and should enjoy the fostering care of the legislatures; but, being carried on by corporations, it has been divorced from public sympathy and made the subject of hostile legislation to an extent not easily explained. In various States laws known as "Valued Policy Laws" have been enacted, compelling the companies to pay the full amount of a policy on a building, regardless of its value at the time of the fire. Other laws have been passed making it a misdemeanor for the companies to form boards or associate together for the establishment of rates. In some States the form of policy is dictated by statute. Many of them require large deposits, and in nearly all "retaliatory laws," so called, exist; and taxation of various forms is laid heavily on the companies in almost all the States; those which levy upon the gross premiums sometimes taxing in excess of the net income—the residue after paying losses and expenses. Official figures tabulated for ten years show that the taxation in one State amounted to 220 per cent. of the net; in three States it was over 100; in four over 60; in seven over 30; and in ten others it ran from 2 to 17 per cent. of the net income. There were, of course, individual companies that were more fortunate than others, but this was the result of the aggregate business.

Co-insurance.—In marine insurance practice a man insures as large or as small a proportion of his vessel or shipment as he chooses and carries his own risk on the remainder, bearing his proportion of losses, total or partial. But in fire the practice has prevailed of collecting the whole of a partial loss from the insurers, even though the owner has paid premiums on only a small fraction of the value. This has induced economical owners of good buildings to take out only as much insurance as would catch the probable losses, compelling the companies to pay in full the partial losses which the whole property produced, while the owner saved the expense of insuring the whole value. This, in turn, has constrained the insurers to adopt what is popularly known as the "co-insurance clause," usually a provision that the owner must be insured on, say, 80 per cent. of the value, or else stand as the co-insurer of any uncovered proportion up to the agreed proportion. Under this clause the companies pay in full on a total loss without regard to the proportion actually insured, but on partial losses the owner contributes with the others, if he has neglected to procure the required amount of insurance.

Fire Prevention.—Intimately connected with the occurrence of fire is the prevention of it; and none are more directly concerned than insurers in such cognate matters as water-supplies, fire departments, building laws, and fire limits, electric and automatic alarm systems, and salvage corps, or "insurance patrols," as they are called in many places. In some of the large cities of the U. S. the insurance companies maintain at their own expense a service whose special duty it is to protect and save goods. A "patrol" consists of a chief and a number of men who occupy premises not unlike a first-class engine-house, which is connected with the local system of fire-alarms and is equipped with horses and wagons to carry men, tarpaulin covers, and other apparatus. Each wagon has one or more chemical extinguishers, and the patrol runs to fires as a supplement to the fire department, where it protects goods from water damage by spreading covers, and otherwise saving property. Measures have been introduced in a number of the States looking to the extension of the duties of coroners by making a fire a casualty calling for the official examination of the coroner for the purpose of ascertaining its cause, and devising means for amending the building laws with a view to fire prevention.

Rating, Classification, Fire Maps.—To what extent fire-insurance is a science and what an art is a question not yet settled. There are those who hold that through a combined experience of the companies rates of premium can be fixed on a basis which would be more or less scientific; while others hold that although it is obvious that some hazards demand a higher rate than others, yet the only safe guide to a proper rate is individual inspection of each particular risk. Many of the companies classify their risks and keep an account with each class, but no effort has yet proved successful to bring the experiences of the different companies into combined form. Schedule rating is the nearest approach to a scientific basis for fixing premiums that has yet been attempted. This, in brief, is assuming a building for a standard which is as nearly perfect as may be in its fire-proof construction, and then making additional charges for each defect or departure from the standard. A comprehensive plan, known as the "Universal Mercantile Schedule," is (1893) attracting much attention among the companies. Fire maps or diagrams have been in use for a great many years. These are ground plans drawn to a scale with various symbols and colors to indicate the material of which each building is constructed, the location of fire-walls, the number of stories, the sort of roof and other things desirable for insurers to know in regard to the locality mapped.

Boards: National, Local, and Otherwise.—As early as 1845, soon after the second "great fire" in New York, an association was formed in that city under whose auspices the first national congress of fire underwriters was called in the following year to devise means to reform existing evils, to adopt bases of remunerative rates, and formulate rules of practice for the more harmonious conduct of the business. It was developed at these early meetings that the profits for the twenty years preceding had been less than 3 per cent. of the premiums, and the danger of continuing a business of such fluctuations as fire-insurance on so narrow a margin was evident. The next attempt of which there is any record was in 1849, when nine principal companies of New York and New England agreed upon a uniform tariff and rules for the government of their agents throughout the country. In 1850 this tariff was modified and so improved that it remained the standard of the U. S., so far as any standard was recognized, for a dozen years or more. Meantime the civil war, which began in 1861, brought confusion to insurance as well as other branches of business, and at the close of that conflict the rates had run down to the lowest recorded point, while the burning line had gone up to the highest recorded point. In 1865 the average rate obtained by the companies was only 74 cents per $100 insured, and losses the following year reached the unprecedented height of 81 cents. Expenses added to this heavy loss resulted in a state of affairs scarcely short of panic. Accordingly, a meeting was called on July 18, 1866, when fifty-seven New York companies and thirty-five from other States met and formed the famous National Board. While the call for this meeting was out, and just two weeks before it convened, a great fire occurred in Portland, Me., wherein $6,000,000 of losses were added to the already crushing burdens resting on the companies. It was life or death, and the utmost harmony prevailed in the meeting. An organization was formed having four objects: (1) the establishment of uniform rates; (2) the fixing of uniform commissions; (3) the repression of incendiarism; (4) the protection of common interests. To an executive committee was intrusted the principal work of the organization, and for two years it was the supreme factor in fire-insurance in the U. S.; but with returning prosperity came jealousies and malpractices, and as soon as that cohesion which seems to be dependent on adversity was relaxed the board fell into decay. The great conflagrations of Chicago and Boston in 1871–72, however, not only revived it but emphasized its necessity, and for several years after those notable conflagrations it controlled fire-insurance with imperial sway. The Chicago fire department yielded to its demands, and was remodeled at its dictation. The private judgment of companies was almost abandoned, and "board rules" were substituted. Company agents were disciplined by men who did not employ them, and numerous acts of arbitrary power finally brought on a reaction which resulted ultimately in a collapse. It still retains its organization, does duty as a bureau of statistics, and awaits the day in which it may again be useful to the companies. The National Board movement was not without fruit, for a number of powerful local associations have grown out of the sentiment and experience generated by that association. The New England Exchange in the Eastern States, the Western Union, centering at Chicago, the Southeastern Tariff Association, and the Pacific Insurance Union are the most notable examples. These all have the same general object of conservative practice over the agency field in regard to rates, rules, and practice. State boards exist also, working on the same lines, and local boards are very numerous.

Compacts.—A remarkable outgrowth of the widespread agency business of the U. S. is a comparatively recent expedient known as the "compact." Originally this was merely a voluntary arrangement among the agents, first at Kansas City in 1882 and afterward at other points. Later on it was taken up in the general interests of the companies, and compacts have been established at a great many important points. To the compact manager the local agents submit their daily transactions, and nothing can go forward to the companies until he has "stamped" it; his stamp indicating that the local requirements as to rate, form of policy, and otherwise have been complied with. Much has been done through the compact to make good practice not only uniform, but easy. A chapter of great interest to insurance men might be written concerning the details of planning and working a compact.

Societies, Journalism.—Germane to the organizations just mentioned, but separate from them and working on other lines, are the literary and semi-literary associations of fire-insurance men. The most notable of these are the Fire Underwriters' Association of the Northwest, the Underwriters' Association of the South, and the Fire Underwriters of the Pacific. These have annual meetings lasting two days or more, at which papers are read and discussions prosecuted which take high rank both for professional and literary excellence. Eminent scientists have lectured and the most notable men in the insurance world have delivered addresses before these associations, but the major part of their work comes from domestic talent which is stimulated by the honor of a public hearing and the publication of papers in the annual proceedings. Insurance journalism is no insignificant factor in the everyday work of insurance in the U. S., where class journalism has had such remarkable development during the last score of years. These journals are usually conducted with great independence, and are useful in spreading abroad among the agents and the companies the current discussions immediately affecting the practice of insurance, thus stimulating and warning in regard to the prevalent practices of the day. The insurance journal takes the place to a considerable extent of book literature in the craft, and furnishes the main supply of professional reading to its various members. Many books are published, however, particularly on the legal side of insurance, so that by reason of these several agencies fire-insurance is not by any means without a literature of its own.

State Departments.—These have been established by the governments of very many of the States, and, while they are usually managed by political incumbents, have had a marked influence upon the insurance business of the country. Between the examinations by the departments and the exposures by the journals, it has become well-nigh impossible for fraudulent insurance schemes to make much permanent headway. The annual statements required under oath from the officers of all the companies by these departments is in the same line and has the same tendency. The commissioners of the several States meet in annual convention for conference, and these gatherings are illuminated not only by discussions of members on current topics of insurance, but by the reading of papers by experts which are usually of a high order of merit.

LITERATURE.—Joseph K. Angell's *Law of Fire and Life Insurance* (Boston, 1855); *Insurance Law Journal* (22 vols., New York, 1870–93); Edmund H. Bennett's *Fire Insurance Cases* (5 vols., Boston, 1872–77); Charles J. Bunyon's *Law of Fire Insurance* (London, 1875); Ostrander's *Law of Fire Insurance* (Chicago, 1892); George A. Clement's *Digest of Fire Insurance Decisions* (New York, 1893); Walford's *Insurance Cyclopedia* (5 vols., London, 1876), and his *Fires and Fire Insurance* (London, 1877); *Insurance Blue-book* (New York, 1876); *Insurance Year-book* (New York, 1880–93); Fowler's *History of Insurance* (Philadelphia, 1888); Griswold's *Fire Underwriters' Text-book* (Montreal, 1889); Relton's *An Account of Fire Insurance Companies* (London, 1893). C. C. HINE.

Fireless Engine: a successor to the ammoniacal gas-engine. Dr. Émile Lamm, a native of France, but for many years a citizen of New Orleans, La., was the inventor and patentee (July 19, 1870) of an engine in which the power was derived from the vapor of ammonia. The ammonia, on escaping from the engine which it propelled, was recondensed (absorbed) by water, over which it was passed. This ammoniated reservoir of water, on being heated to the temperature of about 135° F., gave up the ammonia in the form of vapor. The same vapor was again returned to the engine, and was again allowed to escape, to be absorbed by its bath of water. The detail of the construction of the engine and water-bath need not be given, since the engine has been superseded by the incidental discovery, by Dr. Lamm, of a convenient method of using detached steam for the like purpose. Suffice it to say that the ammonia engine was successfully used in propelling street-cars in the city of New Orleans on the Canal Street railway at the rate of about 8 miles per hour, and with decided economy as compared with horse-power. This was used in the year 1871. While perfecting the methods of applying the ammonia-propelling power, and studying heat in its latent and active forms, Dr. Lamm was impressed with the facility with which the vapor of water may be condensed, even at high temperature, in water under high pressure; and following up the experiments, he was led to the invention of the fireless engine, patented Apr. 9, 1872, and afterward in complete use in New Orleans, but first perfected by Dr. Lamm himself, and applied to the selfsame engine used for driving the ammonia cars.

Fire-proof Building: the science of constructing an edifice not only incombustible, but capable of resisting, without injury to its stability or serious damage to its structure, the action of any fire originating either within its contents or from without. The destructive effect of long-continued and fierce flame upon incombustible materials, such as stone and iron, renders the problem of fire-proof building a difficult one. The burning of stored merchandise, and even the radiated heat of a great conflagration, may suffice to melt exposed iron-work, or at least to soften it until it collapses, dragging floors and walls down with it in a general ruin; it may even fuse the surface of wall-tiling (Athletic Club fire, Chicago, 1892), crack and destroy solid granite masonry from across the street (Boston post-office building, 1872), and cause zinc and copper to burst into flame (Constantinople [Pera], 1870). The gutting of many edifices alleged to be fire-proof, among which have been not a few constructed almost entirely of incombustible material, has led to a popular distrust of fire-proof construction not justified by the real facts; while the experience acquired in these disasters has finally made it possible to reduce the principles involved to clear and definite statement.

The distinction should be carefully drawn between *fire-proof* and merely *incombustible* buildings. The latter, although wholly composed of material incapable of combustion, may be completely gutted by the spread of the fire among their contents from one part to another through hatchways, stairways, and other openings; and may even suffer serious structural damage by the collapse of their metal beams and columns. A *fire-proof* building should suffer no structural damage from either internal or external fire, and should offer an effectual barrier to the spread of the flames from one story or section to another. There is also a third class of buildings which, though built with incombustible walls, floors, roofs, and partitions, are finished with inflammable fittings and decorations. The damage by fire to "fire-proof" buildings has mainly been in structures of this class, which includes a large proportion of modern "fire-proof" hotels, apartment-houses, and office-buildings. Yet the gutting of structures of this class is comparatively rare, because of the difficulty with which the flames acquire mass or headway in them, which would justify their being classed among "slow-burning" buildings, and it is doubtless a fact that the multiplication of such edifices greatly diminishes the danger of general conflagrations in large cities.

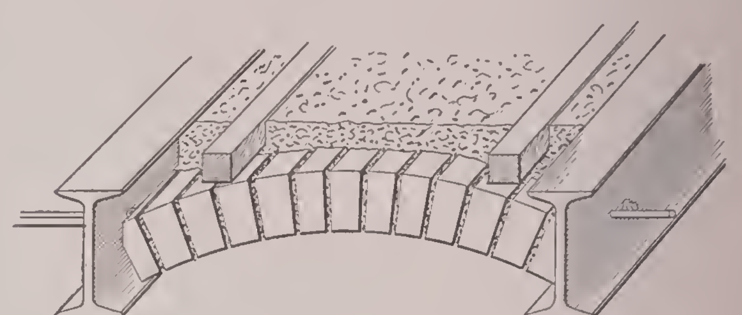


FIG. 1.—Floor-arch of solid brick.

Purposes.—It should be the aim in any system of fire-resisting construction (1) to build wholly of incombustible materials; (2) to protect by non-conducting coverings all exposed structural metal-work; (3) to dispense absolutely, if possible, with inflammable material even for the finishing and minor embellishments; and (4) to oppose every possible barrier to the passage of fire from one part of the building to another.

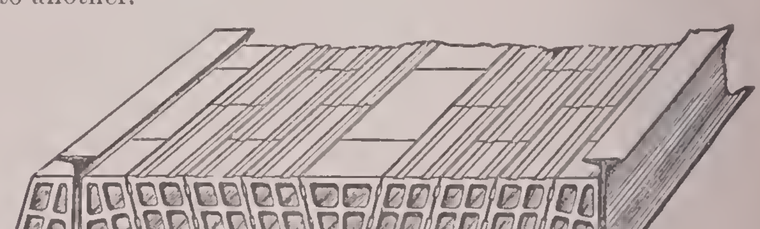


FIG. 2.—Horizontal floor-arch of hollow brick protecting beam-flanges (Maurer's).

Methods.—Burnt clay in the form of brick, terra-cotta, and tiles, is the best fire-resister of all building materials. In its highest form—that of fire-brick—it is practically infusible as well as uninflammable, while even common hard brick will endure a very high temperature. A completely fire-proof building might therefore be composed of brick walls and piers carrying vaulted ceilings and roof of brick, with tile flooring and roof covering. Systems of light and nearly flat vaults of thin, hard-burned tiles have been used in several buildings erected in the U. S., which, by avoiding the excessive cost, weight, and waste of space of ordinary vaulting, have brought this method of construction within the range of practicability for warehouses, libraries, and similar depositories of valuable and inflammable material. But the use of iron and steel for beams and columns, by reason of their economy of space and ease and rapidity of erection, has become practically indispensable for the framing of roofs, stairs, and elevator-ways, and for spanning wide distances without intermediate supports; and modern ingenuity has devised various means for protecting these metallic members from damage by fire. This is usually effected by means of fire-proof and non-conducting coverings or jackets, generally of terra-cotta or fire-brick, though sometimes special compositions of plaster or cement are applied to the metal, either directly or upon casings of wire netting.

Floors.—Floors are usually built of I-beams spaced from 3 to 6 feet, anchored to the walls, tied by continuous tie-rods to prevent spreading, and supporting incombustible fillings or arches, leveled on top with concrete in which are buried sleepers to which the finished flooring is nailed. The fillings, which were in the earlier examples arches of solid brick, as in Fig. 1, usually consist in more recent

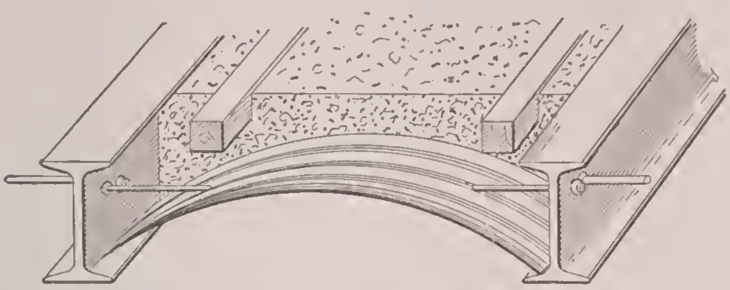


FIG. 3.—Concrete fillings on corrugated-metal arches.

work of flat arches of hollow brick made specially for the purpose, the soffit of the beam being in the best work protected by overlapping "skew backs" (Fig. 2). Such arches may be built of 6 to 8 feet span with a thickness of but 6 inches, capable of resisting a very heavy center-load. Fig. 3 shows a not uncommon system of concrete fillings on corrugated-metal arches, and Fig. 4 an inexpensive but strong arch used in 1870 in Robert College at Constantinople. Fig. 5 shows the common French (Thuasne) system, employing plaster-of-Paris carried by light bars wired to transverse hangers between the beams, a system having little strength and inferior fire-resisting qualities, as was proved by the fearfully rapid destruction of the Magasins du Printemps in Paris in 1880. A New York company has introduced a modification of this system, in which a patented composition capable of resisting both fire and water is molded or cast over wire netting stretched between the beams. It is reported to possess great strength as well as lightness. The "Guastavino" system of light vaults of thin tiles laid flat in cement permits of dispensing

FIG. 4.—Floor-arch of thin hollow brick, laid flat, used in Robert College, Constantinople.

with iron beams, which are replaced by low-crowned transverse arches of tile

Partitions and Roofs.—For light partitions hollow brick are commonly used; while a material called "porous terra-cotta," made in slabs by baking clay mixed with saw-dust,

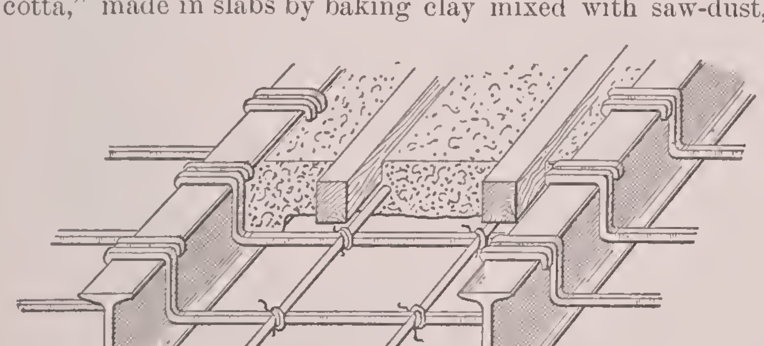


FIG. 5.—Common French (Thuasne) system.

is sometimes used for this purpose, and for filling-in between iron rafters and purlins in roofs; tiles and slates can be nailed to it precisely as to boards. Wooden sheathing should never be tolerated for roofs; if porous terra-cotta is not used, the tiles or slates may be wired to iron rods, or bedded in mortar applied to wire netting secured to closely spaced iron purlins. Roofs are sometimes covered with sheet copper or galvanized corrugated iron, secured directly to light iron purlins, or to a filling of porous terra-cotta or similar material. For covering roofs nearly or quite flat, concrete is often employed, and is in some cases covered with a paving of hard brick, especially when the roof is to serve as a terrace or promenade.

Furrings and Linings.—Wooden furring-strips should be sedulously avoided, and be replaced either by linings of hollow brick or by iron furring-strips and metallic lathing. The latter, of which many kinds are obtainable in the U. S., made of wire netting or of perforated sheet steel, should be used wherever it is desired to apply plastering otherwise than directly to the masonry.

Precautions.—Special attention should be bestowed upon all openings and passages from floor to floor. Every shaft, stair-well, and pipe-chase may serve as a flue to carry the flames from cellar to roof. The architect should plan to reduce all such passages as far as possible, both in area and number. All pipe-chases and passages for wires should be completely stopped at each story by packing with asbestos or plaster. Everything combustible should be kept away from stair-wells and elevator-shafts, and no metal left unprotected in their construction. Especially should hollow spaces be avoided under wooden flooring and behind wainscotings, by applying the woodwork as closely as possible to the surface of concrete or masonry beneath or behind it. Wherever the use of wood for interior finish is unavoidable it should be treated with some fireproofing solution like tungstate of soda. This is a somewhat expensive precaution, seldom observed; but not otherwise can the fire-proof quality of a building be preserved where wood enters into the interior finish, as it must in hotels and apartment-houses. Every large building should be divided into sections by solid brick walls rising some feet above the roof and penetrated by doors, which should be double and made of metal or of two thicknesses of plank entirely covered—the edges as well as the sides—by bright tin, experience having proved the excellent fire-resisting qualities of such doors. Every building containing inflammable contents—such as books, merchandise, records, and the like—should also be provided with fire-proof shutters to all windows as a safeguard against external fires. Such shutters should, if possible, be double, made of steel or wrought iron, and provided with loopholes having pivoted covers to allow of the introduction of hose for extinguishing internal fires. There should also be outlets at each floor for the escape of water thrown in by the engines in case of such fire. And the fire-proof character of the edifice should by no means be an excuse for dispensing with extinguishers, hose, self-sprinklers, and other approved appliances for promptly extinguishing any fire that might start among its contents.

History.—Ancient records teem with surprising tales of the destruction of monumental edifices of solid masonry by the burning of their wooden roofs, floors, and contents. The Roman systems of vaulting were partly a result of the effort to guard against such calamities, yet in 217 A. D. a fire kindled by lightning in the wooden superstructure of the Coliseum destroyed a large part of the masonry of its upper stages. The Romans, in the Baths of Caracalla, anticipated the modern systems of metal beams with concrete fillings, as proved by Lanciani in 1873. The Byzantines sought in the magnificent Church of the Divine Wisdom (Santa Sofia), in 532 A. D., to replace by a fire-proof structure the earlier basilica destroyed by fire; and the whole history of mediæval architecture is that of a constant effort through five centuries to translate into a stone-vaulted and fire-proof structure the traditional forms of the early Christian basilicas. With the development of palace architecture in the Renaissance came a more general use of timber in floors, roofs, and ceilings, and of lath and plaster for interior finishing. These practices, handed down and, in the U. S. especially, fostered by the cheapness of wood and the costliness of mason-work, have led to a great extension of wooden construction and to many vicious and defective methods of building. In regions where timber is scarce, however, the more ancient practice of building vaulted ceilings of masonry still prevails, as in some districts of Italy and Hungary where wooden floor-beams and roofs are the exception. The public buildings of the Old World are in great measure solid and well-built edifices, and the development of metallurgy, leading to the increasing adoption of iron and steel for posts, beams, and trusses, has led to improvements amounting to a revolution in the art of building, in which the most rapid progress and the greatest inventiveness have been displayed in the U. S. Floors of brick arches carried by heavy timbers may be seen in Spain and Southern France, dating from the seventeenth century, but the modern development of this principle dates only from the general introduction of rolled-iron beams into building practice between 1840 and 1850. In the Berlin Museum, by Stüler (1843–55), trussed beams of cast and wrought iron were used with brick arches; during the same period Bunnett's, Fox & Barrett's, and Cheyne's patent fire-proof floorings were invented in England, and the Thuasne and Vaux systems generally adopted in Paris. The Cooper Institute in New York was the first building in the U. S. to employ American rolled-iron joists with brick arches. Since 1876 the progress in methods of fire-proof building has been especially great. This period has also witnessed the adoption, especially in New England, of the so-called "slow-burning" or "mill-construction" system of heavy wooden floors on widely spaced beams of heavy section, described in the articles FLOOR and MILL-CONSTRUCTION.

A. D. F. HAMLIN.

Fireproofing: the process or means of rendering textile fabrics or other materials incombustible. On Mar. 17, 1735, one Obadiah Wyld obtained an English patent for "making or preparing paper, linen, canvas, and such like substances which will neither flame nor retain fire, by mixing alum, borax, vitriol, or copperas dissolved," and dipping the fabrics "into a strong infusion of the said materials in water or thin size made hot." Impregnation with alum, borax, or copperas, as the case may be, is by far the best treatment for fireproofing and preserving wood, which thus treated has been strongly recommended for railway cars subjected to risk of fire from overturned stoves and lamps in cases of collision, etc. The use for fireproofing of sulphate of ammonia was proposed by De Breza in 1838; that of soluble glass by Bethell in the same year; that of hydrochlorate of ammonia by Froggant in 1851, but this last does not appear to have received serious attention. The use of tungstate of soda and phosphate of ammonia was at a later date found by Dr. Versemann, after a series of the most careful experiments, to be the best adapted for common use with cloths, etc., either of these rendering the lightest muslins uninflammable. The tungstate of soda, however, has this advantage over the other, that it may be used with starch and does not interfere with ironing. A mixture of this salt with starch is sold in London under the name of fire-proof starch. The tungstate of soda should be used in preference to the others for light articles of apparel, curtains, upholstery, etc.

A German recipe for fire-proof coating is three successive applications of a hot solution of 3 parts alum and 1 part copperas, and after this of a solution of copperas brought to the consistence of paint by the admixture of pipe-clay.

The disastrous results of fires in theaters and like places of amusement have led to the invention of fire-proof drop-curtains, the material of which could undoubtedly be employed for other but similar purposes. In some of these asbestos is the material most relied upon for the desired fire-resisting properties.

JAMES A. WHITNEY.

Fire-proof Safes: in general, movable receptacles of iron or steel, lined with non-combustible materials, and used for the preservation of papers, money, or other articles of value. The fire-proof safe originated in New York city between the years 1829 and 1832, when James Conner made an iron box filled in with plaster-of-Paris for use in his office. He made no attempt to benefit the public by his invention and the safe was almost forgotten until 1843, when one Fitzgerald invented a similar receptacle. From this date the manufacture of fire-proof safes received a lasting impetus. Numerous new compounds were devised for filling. Although Conner was the first to make a fire-proof safe, William Marr, of London, was the first to patent and make public a method of construction. This he did in 1834. Marr's invention differed materially from Conner's; the former filling the spaces between the inner and outer shells or casings of the safe with sheets of mica pasted upon paper, and crowding the space between with burnt clay and powdered charcoal, or in lieu of these with powdered marble. The next alleged improvement was that of Charles Chubb, also of London, in 1838, who used a series of concentric linings of iron plates, the intermediate spaces filled with baked wood-ashes, or "such other slow-conducting materials as will retard the transmission of heat." In 1843 three gentlemen named Tann originated safes made fireproof by filling the spaces with ground alum, finely sifted, and gypsum, also finely pulverized. The alum and gypsum were intimately mingled, heated to liquefaction, and after cooling to a hard and brittle condition comminuted to a coarse powder for use. This mixture, when subjected to an extreme heat, would give off water from the plaster; but the calcination of the alum of course detracted from its utility. In 1855 George Price, of Wolverhampton, used powdered alum and sawdust as a filling. During the previous use of alum it had been discovered that various other salts containing water of crystallization would serve the same purpose in the filling.

The construction of fire-proof safes has for many years formed a very important branch of manufacture, and many improvements have been made which in the aggregate have much increased their utility. But the essential features remain the same, so that these fire-proof receptacles may still be classified as, 1, those having a filling of some simply non-conducting material, like clay or concrete; 2, those fitted with plaster capable of giving off water by calcination, though only in moderate quantities; 3, those in which alum or other salt yielding a large percentage of water by decomposition is mingled with the plaster; and 4, the steam-safes, in which vessels either of glass or metal and filled with water are arranged between the inner and outer walls to give off steam when subjected to a high heat.

Very many inventions relating to fire-proof safes have been developed in the U. S. since 1850, the greater number relating to the filling upon which the fire-proof quality depends. Among these was one, in 1864, which comprised a filling of alum in small lumps rolled in plaster and then bedded in dry clay. In 1865 a filling of Epsom salts was used, either alone or combined with sulphate of lime or plaster-of-Paris (this also is the filling used in a celebrated fire-proof safe); in 1866, a novel arrangement of vessels containing water between the inner and outer walls to form a steam-safe. In 1868 nearly a score of patents for fire-proof safes were granted; among others, upon wood imbedded in the plaster filling to enhance its non-conducting power, the introduction of non-conducting material between the plates of the door and the door-casings, the use of fine (common) salt as a filling, water-vessels stopped with glue or mucilage inserted in the cement filling, the construction of the set filling with cells for the reception of a vaporizing substance; also several novel forms of steam-safes, in one of which a space external to the water-filling was provided to receive the steam from the filling, and thus provide a non-conducting jacket to the whole. From 1869 dates the use, external to an alum or similar filling, of cans containing steam or vapor-producing substance placed between such filling and the outer casing of the safe; also, the construction of safes with a water-supply from an elevated head. These embody the leading varieties of fire-proof safe construction, although various improvements of more or less merit have been from time to time proposed. It must always be remembered that no safe is absolutely fire-proof, although several manufacturers make them capable of withstanding an exceedingly high temperature. Wherever possible, a safe should be imbedded in brickwork, which experience has shown to be one of the most effective of all protections against the injurious transmission of heat.

JAMES A. WHITNEY.

Fire-ship: a vessel, often old and unseaworthy, which is laden with combustibles, fired, and sent into the midst of an enemy's fleet for the purpose of setting it on fire. This ancient device has been frequently tried in modern warfare, and though sometimes of much service, as in the war of Greek independence, it can never be of much effect when employed against a well-managed steam-marine; moreover, this service is fraught with great danger to the aggressive party.

Fireworks: See PYROTECHNY.

Fire-worshipers: See GUEBRES and PARSEES.

Firishta: See FERISHTAH.

Firkowitsch, feer'kō-vitch, ABRAHAM: Jewish archæologist; b. at Lutzk, in the Crimea, Sept. 27, 1786. He was the son of Karaite parents, and was reared in the faith of his forefathers. (See KARAITES.) Of a ready mind and eager for learning, he was afforded all the advantages which the Jews of the Crimea had at their command. These were but scanty; most of his knowledge consisted, therefore, of a thorough mastery of the Hebrew of the Old Testament canon and of tradition, acquired mainly at Eupatoria, where he had enjoyed the use of a manuscript library belonging to the Karaite congregation. He became a rabbi, and distinguished himself in his connections at Cherson and Koslov. His study of the MSS. at Eupatoria had instilled in him a love for ancient Jewish authors, particularly Karaites, and a desire to see the study of Hebrew literature and of Karaism revived among his nation. His opportunity to urge the matter successfully came in 1825, when the Karaites of Eupatoria established a printing-press. Firkowitsch finally became the principal guide of the Crimean Karaites not only in the reproduction of ancient MSS., but also in the selection of modern works worth printing. Unsatisfied by the meager supply in the Crimea, Firkowitsch visited the scattered Karaite communities in Turkey, Syria, Palestine, Persia, and the Caucasus, not shunning any danger or privation, determined to unearth the treasures of the past. He penetrated into the very depths of Asiatic wildernesses, searching wherever he might hope to find a fragment of Karaite antiquity. He deposited in the Imperial Library at St. Petersburg no less than 1,500 MSS.—a collection said to rival, if it does not surpass, the fine collection of Hebrao-Arabic codices at Oxford. In the deciphernent of these MSS. Rabbi Samuel Pinsker assisted and frequently guided Firkowitsch. They are not yet as widely known as they deserve to be. Neubauer, the Jewish savant at Oxford, and others have drawn attention to the great value of the Firkowitsch fragments of ancient MSS. of the Old Testament, both for the various readings of the Hebrew text and for the Masora. Firkowitsch died at Shufut-Kale, in the Crimea, June 7, 1874. See his *Life* by A. Jellinek (Vienna, 1875) and by H. L. Strack (Leipzig, 1876).

J. H. WORMAN.

Firmament: See STARS.

Firman [from Turk. *fermān*, from Pers. *farmān*; cf. Avest. *framāna*, authority, decision, deriv. of prefix *fra-*: Skr. *pra-*, Gr. *προ-*, Eng. *for-*, forth + *mā-*, measure: Lat. *metior*, whence Eng. *measure*]: in Oriental countries the certificate or written mandate of a sovereign or government. It is especially applied to the passports issued to travelers in Turkish countries.

Fir′micus Mater′nus, JULIUS: a writer on mathematics and astrology; b. in Sicily; flourished in the time of Constantine and his successors. He followed at first the profession of an advocate. He wrote in Latin a work entitled *Matheseos libri VIII.* (about A. D. 354), which treated of astrological subjects, such as nativities, the influence of the stars on human life, etc., more than of mathematics. The work is still extant, and was first printed in Venice (1497) in a purer text than that of Aldus (1499) and of subsequent editors. A new edition is promised by K. Sittl. Evidently, from several passages of his work, the author was a heathen. If the treatise *De errore profanarum religionum*, which is ascribed to Julius Firmicus Maternus, be by the same author, he must in his later years have become a Christian. But it is more probable that this work is by another writer of the same name, who flourished at the same period, as his book is dedicated to Constantius and Constans, the sons of Constantine, and bears internal evidence of having been composed about 347. It is a vigorous defense of the Christian religion against the errors of paganism, which he exhorts the emperors to destroy. The best edition is by C. Halm (Vienna, 1867) along with Minucius Felix. See Hertz, *Dissert. de Julio Firmico Materno* (Copenhagen, 1817). Revised by M. WARREN.

Firozpur: a district (and city) of the Lahore Division, Punjaub, British India; on the left bank of the Sutlej river; between lon. 74° 5′ and 75° 29′ E. Area, 2,752 sq. miles. The country is level, and in part subject to fertilizing overflows of the Sutlej. A railway runs through the district. Pop. 650,000, about one-half Mohammedans. The capital is Firozpur, a city of 25,000 inhabitants, on the old bank of the Sutlej (see map of N. India, ref. 4–D). It is very prosperous and has a military cantonment adjacent to it.

First-born (in Heb. בְּכוֹר, בְּכוֹרָה; Gr. *πρωτότοκος*, LXX. and N. T.; Lat. *primogenitus*, Vulgate): among the Hebrews, the first child of the father and the mother; hence he is spoken of in regard to the father as "the beginning of his strength" (Gen. xlix. 3; Deut. xxi. 17), and in regard to the mother as "the opening of the womb" (Ex. xiii. 2). Before the establishment of the Hebrew theocracy the rights of primogeniture were recognized, but they were sometimes transferred from the eldest to a younger son, as from Esau to Jacob (Gen. xxv. 29–34; xxvii. 18–40), and from Reuben to Joseph (1 Chron. v. 1–3). After the Mosaic economy was established such a transfer was forbidden (Deut. xxi. 15–17). The birthright consisted in a double portion of the inheritance; that is, the eldest son received twice as much of the patrimony as any one of the younger sons (Deut. xxi. 15–17; 1 Chron. v. 1, 2). When Elijah was about to be translated, Elisha said to him, "I pray thee let a double portion of thy spirit be upon me" (2 Kings ii. 9). He meant that, like a first-born son, he might inherit a double portion of Elijah's prophetic prerogatives; not that he should be twice as great a prophet as his master, but, like him, be at the head of "the sons of the prophets"—their superior in office; and so he became. It is nowhere said in the Bible that the birthright embraced the family priesthood and government. As to the family priesthood, nothing specific is recorded. It is likely that the eldest son officiated in place of the father when he was absent, or after his death while the family remained together. To commemorate the destruction of the first-born of the Egyptians, God required that the first-born males of the Hebrews should be consecrated to him; also the firstlings of their cattle and the first-fruits of their ground. After the Exodus their first-born sons, numbering 22,273, were substituted by 22,000 Levites, and the 273 surplus were redeemed at five shekels a head (Num. iii.). The tribe of Levi thus became the priestly tribe for the nation. But how this affected the family priesthood does not appear. So the right of government naturally inhered in the eldest son in the absence of the father, or in the case of his death while the family remained together. This pre-eminence attached to the eldest son in the royal family, as he succeeded to the throne (2 Chron. xxi. 3), though in special cases this rule was reversed; as, e. g., Solomon, who for theocratic reasons was substituted for his eldest brother (1 Kings i.). The first-born son seems to have had authority over the rest of the family from the earliest times; but this appears to be distinguished from the peculiar birthright prerogative, for Esau says of Jacob, "Is he not rightly named Jacob [a supplanter]? for he hath supplanted me these two times: he took away my birthright, and behold now he hath taken away my blessing" (Gen. xxvii. 37). In the blessing, Isaac said, "Let people serve thee, and nations bow down to thee: be lord over thy brethren, and let thy mother's sons bow down to thee" (Gen. xxvii. 29). So it is said that the birthright was taken from Reuben and given to Joseph: "For Judah prevailed above his brethren, and of him came the chief ruler, but the birthright was Joseph's" (2 Chron. v. 1, 2; cf. Gen. xlix. 8–10; Mic. v. 2; Matt. ii. 6). As the first-born was considered more vigorous than younger children, having been begotten and brought forth before the parents had lost their strength, and first developing into manhood, he was naturally invested with superior prerogatives in the family. This has been the case among almost all people. Hence the destruction of the first-born of Egypt was considered so great a calamity, and hence so much importance was attached to the first-born of man and beast that by the Levitical law they were consecrated to Jehovah. The male first-born of men, being represented by the priestly tribe, were redeemed. When the child was a month old the father paid five shekels of the sanctuary to the priest, and so redeemed him. If the child died before he was a month old, the rabbins say the father was excused from the payment. The firstling of an unclean beast was also redeemed, as not fit to be offered in sacrifice. The firstling of an ass, for instance, was to be redeemed by a lamb, otherwise his neck was to be broken. The firstlings of clean animals were not to be redeemed, but offered in sacrifice (Ex. xiii. 11–15; xxii. 29, 30; Num. viii. 16–18; xviii. 15–17).

The term first-born is used metaphorically for the first, or chief, or pre-eminent; thus (Job. xviii. 13), "the first-born of death shall devour his strength"—i. e. the most deadly disease shall destroy him. "The first-born of the poor" (Isa. xiv. 30) are the poorest and most wretched. God said of David (Ps. lxxxix. 27), "I will make him my first-born, higher than the kings of the earth," where the second clause explains the first. David, as the royal representative of the theocracy, enjoyed a higher prerogative than any heathen monarch. In the New Testament *prōtotokos* occurs nine times. Thrice it is used literally (Matt. i. 25; Luke ii. 7; Heb. xi. 28). Christ is "first-born among many brethren" (Rom. viii. 29), as he is "the Son of God" in a peculiar sense—pre-eminent among the sons of God, who are made so through him by adoption and regeneration. He is called "first-born of every creature" (Col. i. 15) or of all creation, as he is "Lord of all," being the Creator of all (cf. Col. i. 16; Heb. i. 1–6). He is called "first-born from the dead" (Col. i. 18) and "first-begotten of the dead" (the same word, Rev. i. 5), because he was the first "raised from the dead to die no more," and so is "become the first-fruits of them that slept" (Rom. vi. 9; 1 Cor. xv. 20). He is called "the first-begotten" (same word, Heb. i. 6), as he was destined to occupy the highest position of honor in the universe (cf. Ps. lxxxix. 27; Phil. ii. 9–11). The righteous are spoken of as "a society of first-borns, registered in heaven" (Heb. xii. 23), because they enjoy the freedom of the city of God, the heavenly Jerusalem: it expresses their pre-eminent dignity and distinguished prerogatives. (Cf. Ex. iv. 22; Jer. xxxi. 9.)

For the subject of the first-born's rights under the English law of primogeniture, see PRIMOGENITURE.

Revised by S. M. JACKSON.

First-fruits (in Heb. רֵאשִׁית; Gr. ἀπαρχαί; Lat. *primitiae*): the earliest gathered fruits of the season. The offering of the first-fruits of the season, with more or less of religious ceremony, is a natural expression of pious gratitude in acknowledgment of the Divine bounty, and was practiced by the ancient Egyptians, Greeks, and Romans, as well as by the Hebrews. The form in which it is first expressly commanded by Moses (Ex. xxii. 29) implies a custom already existing. It may be traced back, perhaps, to the very beginning of history (Gen. iv. 3, 4). Under the Mosaic ritual these offerings were of two kinds—the one national, the other individual. The national offerings were in connection with two of the great national festivals; the first, a sheaf of barley at the Passover, when the barley-harvest began; the second, two loaves of bread at Pentecost, when the wheat-harvest ended. These national offerings, which had a solemn representative character, were to be made, of course, at Jerusalem, and ceased with the destruction of the Temple. The rules to be observed are laid down in Lev. xxiii. Still more minute directions are given in the Talmud. Individual offerings were not merely in acknowledgment of dependence upon God, but also for the sustenance of the priesthood, and were to be made throughout the country, as well as at Jerusalem. Specific directions, bringing out the religious significance of the act, are contained in Deut. xxvi. 1–11. Some kinds of offerings were expressly devoted to the priests' use (Num. xviii. 12), as the best of the oil, wine, and wheat, in addition to which mention is also made (Deut. xviii. 4) of the fleece of sheep. Of young trees no fruits could be taken till the fourth year, in which they were offered to the Lord; after this they might be eaten. Of every kind of produce of the earth, as it ripened, a basketful was to be presented by each Israelite, some in their natural, and others, as wine and oil, in their prepared state. The amount of the gifts of the first-fruits was not specified in the Law, and the field was thus left open for Talmudic casuistry to busy itself in deciding what was proper or obligatory. The gift was not to be taken from the portion designed for tithes, nor from the corners left for the poor. One-fortieth (or, according to the school of Shammai, one-thirtieth) was accounted a liberal proportion of the entire produce, while a moderate portion was a fiftieth, and a scanty portion a sixtieth. But whatever was offered must be the produce of the Holy Land. Beyond Palestine it might be converted into money, and thus sent to the Temple. See Spencer, *De Legibus Hebræorum Ritualibus*, iii. 9.

Fir-wool: a fiber prepared to some extent in Germany from the leaves of *Pinus sylvestris* (Scotch fir), and made into cloth and wadding which are believed to be useful in the treatment of rheumatism and skin diseases. Fir-wool oil is an oil of turpentine made from these leaves. Fir-wool extract is a residual substance prepared from the leaves, and used to some extent in medicine.

Fiscal Departments: See FINANCE.

Fisch, GEORGES, D. D.: a French Protestant clergyman; b. in Nyon, Switzerland, July 6, 1814; educated in the academy at Lausanne. After entering the ministry he preached for nearly five years to a German-speaking congregation at Vevey, and then emigrated to France and joined the French Evangelical Church. Became in 1846 the successor of the celebrated Adolphe Monod at Lyons. In 1854 removed to Paris, as pastor of the church Taitbout, where he was the colleague of his brother-in-law, Edmond de Pressensé, the learned French Protestant ecclesiastic. In 1863 Dr. Fisch became president of the Union seeking the coalition of French Protestants, and was a director of the Evangelical Society of France, a powerful auxiliary to the Union. He figured prominently at the Evangelical Alliance meeting held in New York in 1873. D. in Vallorbe, Switzerland, July 3, 1881.

Fischart, JOHANN: satirical writer; b. (according to some accounts, at Strassburg; according to others, at Mentz, Germany) about 1550; studied law at Strassburg, where he received a doctor's degree in 1574; became advocate to the imperial chamber at Spires in 1581, and in 1583 was made bailiff of Forbach, near Saarbrücken, where he died in the spring of 1590. His numerous writings, comprising both prose and verse, were published under a great variety of pseudonyms, and with strange, fantastic titles. Almost all of them, though satirical in form and abounding in humorous thoughts and oddly coined words, have in general the serious purpose of holding up to public contempt the vices and follies of all classes of society, and especially of vindicating Protestantism against the charges of its enemies. Perhaps the best known of his writings is his free imitation of the first book of Rabelais's *Gargantua* (1575). Of his other works may be mentioned *Aller Practik Grossmutter* (1572); *Eulenspiegel Reimensweiss* (1572); *Flöhhatz und Weibertratz* (1573); and *Bienenkorb das Heilig. Römischen Imenschwarms* (1579), the last a sharp attack on the lives of the dissolute clergy.

Fischer, KUNO: philosopher; b. July 23, 1824, in Sandewald, in Silesia; educated at the Universities of Leipzig and Halle; Professor of Philosophy at the University of Jena 1856–72; since 1872 Professor of Philosophy in Heidelberg. Author of *Diotima, the Idea of the Beautiful* (1849); *History of Modern Philosophy* (1852–72); *Kant* (1860); *System of Logic and Metaphysics* (1865); *Spinoza* (1865); *Francis Bacon and his Successor* (1876); *Lessing* (1882); *Critique of Kantian Philosophy* (1885); *Goethe's Faust* (1886); *Schiller* (1892).

C. H. THURBER.

Fish [M. Eng. *fisch*, *fisc* < O. Eng. *fisc* : Goth. *fisks* : O. H. Germ. *fisk* > Mod. Germ. *Fisch* < Teuton. *fiskos* : Ir. *iasc* : Lat. *piscis* < Indo-Eur. *pisk-*]: any one of many various and widely differing animals having the common characteristic of living in water. The word fish is also used as a collective plural to designate a number of fishes without distinct reference to the individuals. See FISHES and FOOD.

Fish, HAMILTON, LL. D.: lawyer and politician; b. in New York city, Aug. 3, 1808; a son of Nicholas Fish; educated at Columbia College in his native city; graduated in 1828; was admitted to the bar in New York in 1830; was in 1837 chosen to the State Legislature; then served in Congress in 1843–45; was Lieutenant-Governor of New York 1847–49; Governor of New York 1849–51; and from 1851 to 1857 was one of its U. S. Senators. He was in 1862 one of the U. S. commissioners to visit soldiers confined in Confederate prisons, and rendered valuable service in negotiating for the exchange of prisoners. In 1869 he was appointed Secretary of State in the cabinet of President Grant, his term of office commencing in March. Mr. Fish suggested the joint high commission between the U. S. and Great Britain which met in 1871 to settle the various difficulties between the two nations, including the famous Alabama claims. In 1872 he became president of the order of the Cincinnati. In 1873 he was reappointed Secretary of State at the beginning of President Grant's second term, and served till Mar., 1877. D. at Garrisons-on-the-Hudson, N. Y., Sept. 7, 1893.

Fish, NICHOLAS: soldier and politician; b. in New York, Aug. 28, 1758; entered the College of New Jersey at Princeton, N. J., at the age of sixteen, but left, and commenced the study of law with John Morin Scott, with whom he served in 1776 as aide-de-camp, and subsequently as major of brigade; Nov. 21 major of the Second New York Regiment, and at the close of the war was a lieutenant-colonel. Col. Fish was in both battles of Saratoga, commanded a corps of light infantry at the battle of Monmouth, served in Sullivan's expedition against the Indians in 1779, was with the light infantry under La Fayette in 1780, and in 1781 was active with his regiment in the operations which resulted in the surrender of Cornwallis at Yorktown, Va. He was adjutant-general of the State in Apr., 1786, and thereafter for many years. He was revenue supervisor under Washington in 1794, and a New York alderman from 1806 to 1817; president of the New York Society of the Cincinnati in 1797, and a prominent member of many literary and benevolent institutions of New York city. D. in New York city, June 20, 1833.

Fish-culture: a term which in its widest sense means the increase, distribution, and protection of useful and ornamental aquatic animals and plants. The methods and ends involved receive a more nearly adequate expression in the synonymous term "aquiculture," now current in France, since the modern fish-culturist gives attention to many important objects of fishery besides fish, for example, the seals and their allies, the lobsters and other crustaceans, the oysters and other mollusks, corals, sponges, algæ, and the various economic forms of life in the waters.

The Chinese from a remote date have collected, distributed, and hatched naturally impregnated fish-eggs, but the practicability of stocking waters by means of fish developed from artificially impregnated eggs was first made known by Lieut. Stephen Ludwig Jacobi, of Westphalia, in 1763, and the processes were first publicly explained in 1772, by Prof. Adanson in the Royal Garden of Paris. This art was practiced only by private individuals for their own amusement or profit for nearly a century after its discovery. Public fish-culture dates from 1850, when France established, at Hüningue, the first fish-hatchery under Government direction.

The methods and results of the French and British fish-culturists were promptly made known in the U. S. through the publications of Dr. Theodatus Garlick and William H. Fry, whose contributions to the history of fish-culture in Europe were nearly simultaneous; but Dr. Garlick gave the first practical application of the art in the development of eggs of the brook trout. Massachusetts appointed the first State Fish Commission, but New Hampshire, in 1865, first began public fish-culture by importing and hatching salmon-eggs from Canada. A commission was established by Vermont in the same year. The first public fish-hatchery erected in the U. S. was the shad station of Massachusetts at Hadley Falls, on the Connecticut river. At the present time forty States and Territories have fish commissions in more or less active operation, with annual appropriations ranging from $1,500 to $34,000, and the aggregate annual appropriation nearly $250,000.

The U. S. Fish Commission was established by Congress in 1871, and began the artificial propagation of fish in 1872. Prof. Spencer F. Baird was the first commissioner under the Government, and served until his death in 1887, when he was succeeded by Dr. George Brown Goode. The later commissioners have been Marshall McDonald, 1888–97; J. J. Brice, 1897–99; and George M. Bowers, 1899–. The commission has thirty-six stations in operation in twenty-four States. The appropriations for the fiscal year ending June 30, 1900, aggregated $446,500.

The impregnation of fish-eggs is effected by gently pressing a female fish in the spawning condition along the sides of the belly with the thumb and forefinger, and letting the eggs flow into a clean, dry pan. In a similar way the milt from a male is squeezed upon the eggs, the pan being kept swaying until fertilization is effected. A little water is sometimes added before fertilization is complete, and this is continued until the eggs become hard and increased in size. Hatching takes place in glass jars, wooden troughs, or some other form of apparatus, through which there is a constant flow of water.

The extent of the work accomplished by the States is shown in the reports of their fish commissions: Wisconsin distributed 50,000,000 of young fish in 1891 and 36,000,000 in 1892, besides planting some fertilized eggs on the spawning-grounds. New York deposited more than 38,000,000 in 1891. Pennsylvania, during the three years ending with 1891, distributed upward of 152,000,000, averaging about 51,000,000 a year. Michigan furnished more than 136,000,000 in 1891 and upward of 135,000,000 in 1892. Six States have cars specially constructed for the transportation of fish and eggs to and from their hatcheries, and the U. S. has four cars for the same purpose. From 1872 to 1882 the U. S. Fish Commission distributed 341,096,977 fish; from 1882 to 1892 the number distributed was 2,391,389,410; in 1900 1,164,336,754 were distributed, an increase of about 100,000,000 over the preceding year.

Among the many results accomplished by fish-culture may be mentioned the introduction of European salmon and trout into New Zealand and Australia; the successful transfer of trout from the U. S. to Japan, Great Britain, and the continent of Europe; the acclimation of the black bass in Great Britain and Germany; the introduction of several species of European trout into the U. S.; the transfer of shad and striped bass from Eastern rivers to California; and the remarkable increase in the catch of shad in the Eastern U. S. since 1880. The number of shad taken in 1890 was nearly two and a half times as great as in 1880, and the increase in the yield was worth $823,965, notwithstanding that the average price per pound in 1890 was only eleven cents as against nineteen cents in 1880.

The number of species of fish to which the methods of fish-culture are now applied by the general Government and the States is not far from forty. The shad, whitefish, pike-perch, cod, and several members of the salmon family receive the greatest amount of attention. The Dominion of Canada appropriates about as much annually to public fish-culture as all Europe, while the U. S. devote to the work many times the amount granted in Europe and the Dominion. A full description of the history, methods, results, and literature will be found under PISCICULTURE.

TARLETON H. BEAN.

Fisher: the largest of the martens; the *Mustela pennantii*, a carnivorous quadruped of the family *Mustelidæ*, found in Canada and the U. S., arboreal in its habits, and named, as it is said, from its fondness for fish, which it often steals from the traps of fur-collectors, who use fish as a bait for the pine-marten. It is some 3 feet long, inclusive of the tail. In color it is chiefly black, often with gray or brown tints toward the head. It is a fierce nocturnal animal, living chiefly upon birds and small quadrupeds. Its fur in winter is good, and is much used.

Fisher, Hon. CHARLES, D. C. L.: politician; b. at Fredericton, New Brunswick, Canada, Sept., 1808; graduated at King's College, New Brunswick; studied law and was admitted to the bar; was elected to the provincial Parliament in 1837. In 1848–57 he was a member of the executive council; in 1852 a commissioner to codify the provincial statutes; from Oct., 1854, to May, 1856, was attorney-general, again in 1856–61, and again Apr., 1866. He advocated the union of all the provinces of British America, and in 1867 was a member of the conference in London which arranged the terms of the union. He was a judge of the Supreme Court of New Brunswick from 1868 to his death, Dec. 8, 1880.

Fisher, FRANCES C.: See the Appendix.

Fisher, GEORGE JACKSON, M. D.: b. in Westchester co., N. Y., Nov. 27, 1825; graduated in medicine at the medical department of the New York University, Mar. 1, 1849; physician and surgeon of the departments of the New York State prisons at Sing Sing in 1853–54; resigned (after twenty years' service) surgeon Seventh Brigade N. G. S. N. Y. 1873; president of Medical Society State of New York 1874. Author of *Biographical Sketches of Deceased Physicians of Westchester County, N. Y.* (1861); *On Animal Substances employed as Medicines by the Ancients* (1862); *Diploteratology, an Essay on Compound Human Monsters*, (pp. 200, 33 lithographic plates of 126 figures, 1865–68); *On the Influence of Maternal Mental Emotion in the Production of Monsters* (pp. 55, 1870). After the death of the distinguished Dr. Gross, of Philadelphia, Dr. Fisher was chosen his successor to write a *History of Surgery* for the *International Encyclopædia of Surgery*. D. at Sing Sing, N. Y., Feb. 3, 1893.

Fisher, GEORGE PARK, D. D., LL. D.: b. in Wrentham, Mass., Aug. 10, 1827; graduated at Brown University in 1847, and studied theology at New Haven (1848–49), at Andover, where he graduated in 1851, and in Germany. Became Professor of Divinity in Yale College in 1854, and in 1861 was transferred to the chair of Ecclesiastical History. The degree of D. D. was conferred on him by his alma mater (1866), by the University of Edinburgh (1886), and by Harvard College (1886), and the degree of LL. D. by the College of New Jersey (1879). Has published *Essays on the Supernatural Origin of Christianity* (1865); *Life of Benjamin Silliman* (1866); *History of the Reformation* (1873); *The Beginnings of Christianity* (1877); *Faith and Rationalism* (1879); *Discussions in History and Theology* (1880); *The Christian Religion* (1882); *The Grounds of Theistic and Christian Belief* (1883); *Outlines of Universal History* (1885); *History of the Christian Church* (1888); *Manual of Christian Evidences* (1890); *Colonial History of the United States* (1892); and many articles in the *Bibliotheca Sacra*, *North American Review*, *British Quarterly* and *New Englander, etc.*; in 1892 became one of the editors of *The Yale Review*. He was for several years after 1886 one of the editors of *The New Englander*.

Fisher, JOHN: Bishop of Rochester; b. at Beverley, Yorkshire, about 1459; took his M. A. at Cambridge University in 1491; in 1501 became vice-chancellor of the university, and in 1504 chancellor and Bishop of Rochester. In 1505 was president of Queen's College, Cambridge, and on May 12, 1521, preached against the Reformation on the occasion of burning

Luther's writings; besides this, in opposition to the Lutheran doctrines, he wrote several treatises. In 1530 he opposed the divorce of Henry VIII. from Catharine of Aragon, was imprisoned in the Tower of London in 1534, and, receiving the cardinal's hat from Pope Paul III. May, 1535, was convicted for denying the royal supremacy on June 17, and executed at London, June 22, 1535. See his *Life* by J. Lewis (2 vols., London, 1855) and his *Life* by T. E. Bridgett (1888).

Fisheries: those industries which consist in the taking for commercial purposes of fish or of any other kind of aquatic animals, such as seals, whales, clams, corals, and sponges. The term fishery means fishing for business, as distinguished from angling, which is fishing for sport, and implies the use of fine tackle for the capture of active, well-flavored fish.

In an article like this the most general treatment only is possible, and the most important fish and fisheries can alone be treated of at length, while a mere enumeration of others must suffice. It is hardly too much to say that almost every common fish is somewhere caught and used for food, often in considerable numbers, without being the object of any particular "fishery." It may also happen, as is pre-eminently the case on the Great Lakes of North America, that large fisheries may be carried on having as their object the catching of fish in general and no one species in particular. The subject of the fisheries of the U. S. is dwelt on at special length in this article, not only because of their importance, but because detailed information concerning them is much more accessible than it is for other countries.

It has seemed best to discuss the fishes in their natural groups, giving under each some of the more important methods of capture, and to preface this with a description of the general types of apparatus used.

Apparatus.—Under this head come hooks and lines, nets, traps, and spears. Hooks and lines are naturally proportioned in their sizes and lengths to the various kinds of fish and various depths of water for which, and in which, they are used. They may be classed as hand-lines and set-lines, long lines or trawls. These three names are applied to long lines having attached to them at regular intervals short lines armed with hooks. At either end is an anchor to hold the trawl in place, furnished also with a line and buoy to indicate its position.

For cod-fishing trawls usually have the hooks 6 feet apart, and are set in lengths of 3,000 feet, although two or three of these lengths are frequently combined.

A full set of trawls for a fishing-schooner is 72,000 feet, or over 12 miles, long, and is furnished with 14,000 to 15,000 hooks. The difficulty of hauling trawls in deep water (and they are used at depths of from 600 to 1,500 feet) is so great that boats are provided with little winches, known as hurdy-gurdies. Trawls were first used on the Grand Bank of Newfoundland by French fishermen and it was a long time before they were adopted by North American fishermen. Although usually allowed to rest on the bottom, the Italian fishermen use trawls having at alternate intervals a float and an anchor, this arrangement causing the main line to assume the form of triangles, the hooks at the base taking such fishes as dwell at or near the bottom, while those near the apex capture such species as swim nearer the surface. The terms trawl and trawling have such different significations in different localities that it is often necessary to specify just what is meant. In the U. S. trawl always means a long line as described above; in England it means beam trawl, a kind of net; and in Scotland trawling is applied to the use of haul-seines for catching herrings. Trolls, drails or trails are modifications of hand-lines used from boats in rapid motion for taking active, predatory fish, such as the bluefish and barracuda.

The hook either has its upper part imbedded in lead or tin, or has attached to it a piece of bone, bright metal, rag, or bait of some kind.

The most important nets are gill-nets and seines. These are both long, straight nets kept in a vertical position by having the lower edge weighted with lead or stones, while the upper edge is buoyed up by means of cork, wood, or glass floats. Glass floats, which are now so extensively used, seem to have originated in Europe, and as they are made of strong green glass in the shape of hollow balls and are covered with netting, they are extremely durable. They have the merits of never becoming water soaked, and of being much cheaper than cork floats of equal buoyancy. Gill-nets are either anchored in position or set across the current of moving water and allowed to drift with stream or tide, the object in either case being to capture fish by their becoming entangled in the meshes of the net. Gill-nets are used not only at the surface but at the bottom, as in the cod gill-net fishery, the sinkers used being sufficiently heavy to overcome the resistance of the floats. Or, as in the European herring-fishery, the upper rope of the net may be attached to buoys by ropes and lowered to any desired distance below the surface.

Seines are long nets which are drawn around a shoal of fish, or around a locality where fish are supposed to be, in order to surround them. When set from shore, one end of the net is fixed, while the other is carried around to form an immense circle, and then drawn in by man, horse, or steam-power, according to the size of the seine. Some of the Albemarle Sound shad-seines are nearly 1½ miles in length, while one used at Stony Point, on the Potomac, had a length of 3,400 yards, or nearly 2 miles. Seines are used in localities where the bottom is comparatively level and free from rocks or other obstructions, as otherwise, as the foot of the seine is dragged over the bottom, fish would escape beneath it or the net would be torn. In purse-seines, such as are used in the mackerel and menhaden fisheries, a rope is run around the bottom of the net in such manner that the lower part of the net can be drawn together so as to form an immense bag or pocket. Mackerel purse-seines are from 900 to 1,500 feet long and from 160 to 180 feet deep, and are naturally used only in deep water. They are not set directly from the vessel carrying them, but from large row-boats.

The beam-trawl, which is so characteristic of the North Sea fisheries of Europe, is a triangular, bag-shaped net, whose wide, open end is attached to a beam supported on iron runners. The lower edge of the bag is weighted, and, as the apparatus is dragged over the bottom of the sea, the low-swimming or ground-haunting fishes are swept up by it and pass into the hinder end, which forms a pocket from which they can not escape. A large trawl-net is about 80 feet long, and has a beam of 30 to 50 feet. The beam-trawl can be used to advantage only where the bottom is comparatively smooth, and it is particularly adapted for taking flat fishes. Related to the beam-trawl is the drag-net or paranzella of the Italian fishermen, now coming into use on the Pacific coast. This is a bag-shaped net with wings or leaders, but the upper edge is kept clear of the bottom by floats, and the net is extended by having the drag-lines attached to spars projecting from the sides of a boat. Or it may be dragged between two boats, or, even when small and used in shallow water, between two men.

The term traps includes a large number of devices, from small wickerwork affairs, constructed on the plan of a rat-trap, up to pound-nets and weirs and the deadly fyke-net. This consists of a rather long, cylindrical net, kept open by hoops, and terminating in a pocket entered by a funnel-shaped opening. From the open end of the net are stretched long, straight nets, termed leaders, their object being to *lead* the fish to the mouth of the trap. Fyke-nets are set at or near the bottom, being supported by stakes, and are very extensively used both on the coast and in lake fishing, being subject to almost endless modifications in the arrangement of pockets and leaders, according to the locality in which they are used and fish that they are intended to catch. Pound-nets are long, straight nets, usually leading from near the shore into deeper water, and having at the outer extremity a square or bag-like net so arranged that fish once within its bounds can not escape. Fish moving along the shore reach the leader, as the straight net is called, and follow it down to the trap. Pound-nets are set in water of moderate depth, rarely as much as 75 feet, and are supported by stakes. The leaders are from 500 feet to 1,400 feet long, and very long nets may have two or more pockets. Among the advantages of pound and fyke nets is the fact that the fish are kept alive and not lost if the fishermen are prevented by rough weather or other causes from visiting their nets regularly.

A weir is practically a structure on the principle of a pound net, built largely or entirely of stakes, boards, or brushwood. Weirs are generally used in salt water, where there is considerable rise and fall of tide, which allows such structures to be readily built, while the use of brushwood obviates the expense of a net. They are extensively used along the coast of New England.

Although limited in its use to rivers with a swift current, and practically restricted to the Columbia river, Oregon,

AMERICAN FOOD FISHES

the fish-wheel deserves mention from the ingenuity of its construction and its deadly effects. It is a large undershot wheel, whose buckets or floats are represented by large wire nets or scoops with their mouths facing down stream. As the fish come swimming up stream they are scooped up by the ever-turning wheel, and, as it revolves, tumbled out on an inclined plane and slide into a receptacle at its base.

While the cormorant can hardly be called a fish-trap, as is well known this bird is successfully employed in China and Japan for the capture of certain kinds of small fishes.

Spears, grains, or gigs of various patterns are used to a considerable extent for taking some fishes, and on the New England coast play an important part in the capture of flounders and eels. The use of spears for taking fish swimming at or near the surface, and the hook and line for catching those below it, are the most primitive methods, and the progress of a fishery is marked by the abandonment of devices for taking fish singly and the employment of nets and traps by which scores or thousands are caught at a time.

Fishing-gear of various sorts, such as trawls, nets, seines, and very often hand-lines, is tarred or tanned to preserve it from rotting, and especially in Europe the sails of fishing-boats are also tanned.

The subject of fishing-boats can not be treated in the same general manner as fishing-gear, for not only does each nation have its own types of vessels, but almost every locality has its own peculiar craft. In a very broad way the fore-and-aft rig may be said to be characteristic of North America, luggers of the north of Europe, and feluccas of the south of Europe. The schooner is pre-eminently *the* fishing-vessel of the U. S., and has been greatly improved in size, speed, and safety. Steamers are extensively used in the fisheries of Great Britain, and have been introduced on the Pacific coast of the U. S. They are important factors in the fisheries of the Great Lakes, and in the capture of menhaden along the coast. The majority of the British whaling-vessels and one-tenth of the whaling fleet of the U. S. are steamers, and the extensive seal-fisheries of Newfoundland are carried on by their aid.

Specific Fisheries.—The sharks (*Squali*) are regularly caught along the shores of Japan and at various localities in the East Indies, notably Kurachi, the fins being salted, dried, and exported to China, and the skin being used for the manufacture of fancy articles. Off the coasts of Norway and Iceland the sleeper-shark (*Somniosus microcephalus*) is systematically taken with hand-lines for the sake of its liver, which yields a large quantity of oil. During the winter, when the sharks approach the shore, the fishery is partly carried on in open boats; but in summer it is necessary to go farther from land, and schooners of from 20 to 80 tons are employed. The oil-shark (*Galeorhinus galeus*) is taken in some numbers on the coast of California, and quantities of dogfish (*Squalus americanus*) are captured on the New England coast with hand-lines and trawls for the oil yielded by their livers. Skates and rays (*Raiiæ*) are comparatively little used for food in the U. S. on account of their ugly appearance; but they are brought into some markets, and in 1889 the quantity brought into San Francisco was 75,000 lb., valued at $3,750. In many countries of Europe and Asia skates are more extensively used, *raie au beurre noire* being in France justly considered a delicacy; while in Japan, in addition to being eaten, the extremely rough skin of some species is in demand for covering boxes, sword-hilts, and other articles.

The chief species of sturgeons (*Acipenseridæ*) used for food are the Chinese sturgeon (*Acipenser sinensis*), the lake sturgeon of the U. S. (*A. rubicundus*), the California sturgeon (*A. transmontanus*), the Russian sterlet (*A. ruthenus*), and the common *Acipenser sturio* from Europe and Eastern North America. The flesh is used fresh and salted, but is rather coarse and oily. It is extensively used after having been smoked, when it is often sold as smoked halibut. The swimming bladders are made into isinglass, the roe salted into caviare, and the heads, skins, and refuse made into fertilizer. In the U. S. the most important fishery for sturgeon alone is on the Delaware, but vast numbers are taken on the Great Lakes, in connection with other fish. On the Delaware large gill-nets are used, but sturgeon are taken largely in pound-nets also. The Chinese have a barbarous and destructive mode of catching these fish, which they have introduced into California, by suspending bunches of barbless hooks at short intervals from a long line so hung as to just clear the bottom. The sturgeon catch on the hooks, and in their struggles to escape usually become caught in other adjacent hooks. The catch of sturgeon in the U. S. for 1888 was 11,031,539 lb., valued at $231,780, while the Dominion of Canada is credited with sturgeon to the value of $102,127.

The caviare manufactured in the U. S. is largely exported, one firm having shipped 50 tons in a single season. In 1885 477,020 lb. of caviare and 7,297 lb. of isinglass were made on the Great Lakes. In 1888 the product of caviare in the U. S., aside from the Great Lakes, was 318,960 lb.; value, $35,619. These figures seem small when compared with those for Russia, which exports caviare and isinglass to the extent of $1,500,000.

The catfish family (*Siluridæ*), although containing many species which are eaten, is rarely the special object of any fishery, its members being taken with other fish in pound and fyke nets. Small trawls, or trot-lines as they are termed, are, however, employed in some localities. The aggregate catch is large, that of the Great Lakes alone amounting in 1889 to 1,930,050 lb., worth $61,017, more than two-thirds coming from Lake Erie.

The suckers (*Catostomidæ*) are taken with other fish in pound-nets, but their flesh is as a rule so coarse and insipid that their market value is comparatively small, although with other "refuse" fish they form one of the sources of fish-oil. Neither can the carps (*Cyprinidæ*) be very highly commended as food-fishes, although the species are widely distributed, especially in the Old World. The common carp, however, is largely used, since it can be easily propagated on an extensive scale, and has for a long time been semi-domesticated in China and Germany, where it furnishes a cheap and abundant article of food. This species has been extensively introduced into the Southern and Western U. S., being particularly adapted to shallow, sluggish, and warm waters.

The herring family (*Clupeidæ*) is of great commercial importance, not only because many species are used as food, but because they furnish a part of the natural food of such fish as the cod and halibut, and are hence extensively used for bait in some fisheries.

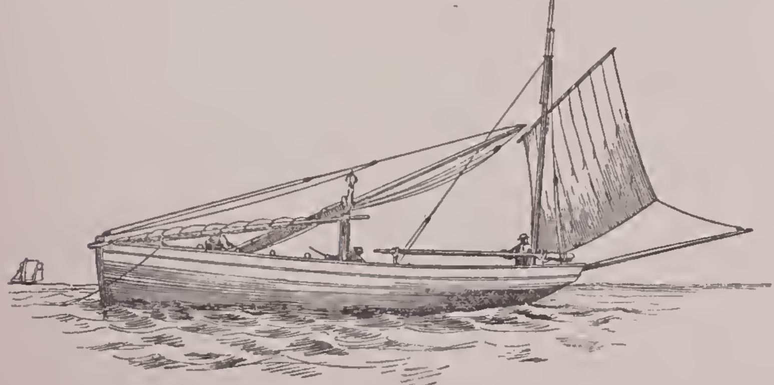
A prominent member of the herring family, and perhaps the most toothsome of all, is the shad (*Alosa sapidissima*), which occurs on the Atlantic coast of North America, from Florida to the St. Lawrence, and has been introduced into the Mississippi and some of the rivers of the Pacific coast. It ascends the rivers in spring to spawn and is taken in seines, gill-nets, or pound-nets, according to the abundance of fish and the conditions under which the fishery is carried on. An allied species is taken in the Yang-tse-Kiang, China, and two others, the allice shad (*Alosa alosa*) and twaite shad (*A. finta*), ascend the rivers of Europe. None of these, however, equal in flavor or importance the American fish. The alewife, often termed herring or branch-herring (*Clupea vernalis*), is the object of extensive fisheries from Maine to North Carolina, being taken with seines, pound-nets, and in some small streams even with dip-nets. Two allied species of much less importance are *Clupea æstivalis* and *C. mediocris*. The alewife is salted on a large scale, used fresh and smoked. The catch for 1888 was 46,601,167 lb., worth $505,281.

The sea herring (*Clupea harengus*), the herring *par excellence*, is taken abundantly on the northwestern shores of Europe and on the coast of North America from Maine to Labrador. This fish is found during the spawning season in such vast shoals that 1,000 barrels are sometimes taken at one haul of a seine. The frozen-herring trade is peculiar to North America, the fish being taken in winter on the coasts of Newfoundland, New Brunswick, and Nova Scotia, frozen solid, and transported to the U. S. where they are used as food, and for bait in the winter cod-fishery. The trade is financially somewhat hazardous from the fact that while herrings may be abundant at the fishing-stations, if the weather is mild they can not be frozen, and, on the other hand, the temperature may be low and fish totally lacking. Artificial freezing has, however, been successfully accomplished. In 1889 forty-six U. S. vessels brought to the New England States 22,524,000 lb. of frozen herring, having a value of $279,297. An important use of herring in the U. S. is in the preparation of "sardines," these being simply small herrings cooked and put up after the manner of the true sardine (*Clupea pilchardus*), a fish which occurs in the Mediterranean and on the western coast of Europe. This industry, which is chiefly carried on in the eastern part of Maine, ranks first among the shore fisheries, the product in 1889 being valued at $1,676,105. The Canadians also have interested themselves in the "sardine" industry, and the product of their canneries for 1891 amounted to $71,412. Incidentally, canned herring appear under the disguise of "brook trout." The majority of small herring as well as many others are taken in weirs built of brush, but seines and gill-nets are extensively used, and in some localities numbers are taken at night by "torching." In "torching" a boat is provided with an iron frame projecting from the bow in which a fire is kindled. The fish are attracted by the light, and scooped up with a dip-net as the boat is rowed rapidly forward. The bulk of the herring catch is disposed of fresh, but vast quantities are also smoked or salted, and in this form exported, largely to Europe.

While the herring-fisheries of North America are to a great extent shore-fisheries, those of Great Britain, Norway, and Sweden are mostly carried on from boats, and the herring are taken almost exclusively in gill-nets by the method known as drift-net fishing. Some fishing has been done with seines on the west coast of Scotland, but has always met with bitter opposition from the majority of the fishermen. The boats employed in drift-net fishing vary in size and rig according to locality, but those of the first-class are luggers of from 15 to 20 tons and decked over. Several nets are used, fastened to one another in a long line, 80 to 130 nets being used, the whole forming a "train" a mile to a mile and a quarter in length. As the floats on the upper edge of the nets are not sufficient to support them they are attached to buoys by ropes varying in length according to the depth at which the fish are supposed to be swimming. A strong rope or warp is fastened to the lower edge of the nets for the purpose of hauling them in, as well as to secure the nets in case the upper part should be torn by a passing vessel. The foremast is lowered in order that its weight may not add to the rolling of the vessel, and the boat rides by the warp with just enough sail set to steady her.

Yarmouth, which furnishes large quantities of red herrings, besides the well-known "bloaters," is the chief port of the English herring-fishery, and Lowestoft comes next in importance. Scotland exports large quantities of pickled or white herring, and Ireland has a herring-fishery which in ordinary years excels that of the New England States. It requires the aid of figures to convey an adequate idea of the importance of the herring. Great Britain takes herring to the value of $8,584,908, Norway to the value of $3,000,000, France reports a catch worth $1,969,600, and Holland $1,600,000, while $1,000,000 is a low estimate for Denmark, Russia, and Germany. The British provinces of North America are credited with herring to the extent of $2,639,000, and New England with the comparatively low sum of $330,000, making in round numbers an aggregate of $19,125,000, an amount well within the mark.

The true sardine (*Clupea pilchardus*), known in England as the pilchard, and the well-known sprat (*C. sprattus*) are also important members of the herring family, and another



Lowestoft herring-drifter.

species (*C. toli*) occurs abundantly on the coast of Sumatra, 14,000,000 or 15,000,000 being taken annually, the fish being dried and the smoked roes exported to China. Local but comparatively undeveloped herring-fisheries also exist in the vicinity of the Canary islands. The abundance of sardines may be inferred from the fact that the Spanish fishermen take annually about 100,000 tons of these little fishes, having a value of from $400,000 to $600,000. A peculiar method of capturing sardines at night prevails in the Adriatic. The location of the shoals of fish is literally felt out by a light sounding-line, and by means of the attraction of a fire of resinous pine the fish are slowly coaxed into some creek or estuary and surrounded with a seine. The demand for wood for use in this and other night fisheries causes a serious drain on the pine-forests around the shores of the upper Adriatic.

Another valuable member of the herring tribe is the menhaden, mossbunker, or porgy (*Brevoortia tyrannus*), which is the object of important fisheries peculiar to the Atlantic coast of the U. S., New York, Connecticut, and Rhode Island being foremost in this field. The menhaden is very erratic in its movements, as is well shown by the Maine fishery, which, formerly prosperous, was practically abandoned between 1880–86 owing to absence of fish, and is again assuming considerable proportions. Menhaden approach the coast in immense shoals, swimming at or near the surface of the water, and great numbers are taken in purse-seines, although pounds and weirs play an important part, and gill-nets are also used, especially by the smaller craft. One peculiarity of the menhaden-fishery is the employment of steamers, which have great advantages over sailing craft, not only in cruising for fish but in transporting them to the factories where they are ground and pressed. A small portion of the catch is used fresh, canned, or salted, but most of the fish are used for the manufacture of oil and fish guano, this being particularly rich in nitrogen. In 1888 55 steamers and 66 sailing vessels were engaged in the menhaden fishery; the products were 2,818,097 gal. of oil and 918,211 tons of scrap; total value, $2,393,629.

The members of the salmon family (*Salmonidæ*) are mostly confined to the northern hemisphere, and many species are anadromous, residing the greater portion of their time in the sea, but ascending rivers to spawn. Large numbers of salmon are taken with gill-nets and traps in Great Britain, Norway, Russia, and other parts of Europe, and there are extensive fisheries in Eastern Asia, including Japan. A small number of salmon are taken in Maine, many more in the British provinces, but the most valuable of the salmon-fisheries are on the northwest coast of North America, and especially on the Columbia river.

The most important species is the quinnat or king salmon (*Oncorhynchus chouicha*) but the blue-back salmon (*O. nerka*), and the white salmon (*O. kisutch*), and Gairdner's trout (*Salmo gairdneri*), are also commercially valuable. The fish are taken on their run up the rivers by gill-nets, seines, pound-nets, traps, and fishing-wheels, and are chiefly used for canning, "Columbia salmon" being exported to all parts of the world.

The extent of this industry is shown by the fact that in 1888 the value of salmon canned in the Pacific States was $3,703,838. In 1891 the Dominion of Canada reported salmon canned to the value of $1,522,508, nearly all from British Columbia.

The future of these great salmon-fisheries appears to depend largely on the possibilities for artificial propagation on an extensive scale, coupled with rigid protective laws, appliances for taking fish having so multiplied that the salmon have decreased in an alarming manner. The value of protection is well shown by a comparison of the returns from the salmon-fisheries of Great Britain with those for the Eastern U. S., where salmon were formerly abundant. The reports of England and Wales for 1887, and of Scotland and of Ireland for 1888, show that the value of salmon taken was respectively $464,095, $1,166,490, and $1,622,987, the total $3,253,572, nearly equaling the value of the product of the Pacific coast fisheries of the U. S. In 1889 the salmon-fishery of the Eastern U. S. yielded $34,118, all but $288 worth coming from Maine. In 1891 Canada and Newfoundland took salmon of the value of $1,712,762, exclusive of salmon used for canning.

The smelt (*Osmerus mordax*), although but a small relative of the salmon, is of considerable importance, the catch of this little fish in the rivers of Maine alone amounting in 1889 to 1,055,385 lb., worth $74,977, while the catch of salmon was but 152,740 lb., worth $34,118. The figures for Canada are even more striking, being $298,951 for the same year. The smelt occurs on both coasts of North America in cold waters and is taken in weirs, by small seines, dip-nets, and hook and line.

The eulachon, or candle-fish (*Thaleichthys pacificus*), and the surf smelt (*Hypomesus pretiosus*) are two abundant and toothsome relatives of the smelt, found on the northwest coast of North America. Another valuable little fish is the capelin (*Mallotus villosus*) which occurs in vast numbers on the northern shores of the Atlantic and Pacific during the spawning season. Although it is dried in great quantities for winter's use both in Kamchatka and on the shores of the U. S., the importance of the capelin is largely due to the fact that it furnishes subsistence to the cod and halibut, and at certain seasons is extensively used as bait for taking those fishes. The whitefishes (*Coregonus*), of which about forty species are known from the lakes of north temperate Europe, Asia, and America, are prized for food, and are the objects of numerous local fisheries with seines, pounds, and gill-nets. The pollan (*Coregonus pollan*) of the Irish lakes is, at the spawning season, very abundant, and the cisco or lake herring (*Coregonus artedi*) of the Great Lakes sometimes occurs in such enormous numbers that the pound-nets are completely filled with them.

The most valued species, however, is the whitefish of the Great Lakes (*Coregonus albus*), of which 15,326,488 lb., worth $691,563, were taken in 1889 by fishermen of the U. S., while the catch of the Dominion of Canada amounted to $685,096. This fish is unfortunately decreasing to a serious extent, probably on account of over-fishing, for the catch of 1880 was more than 6,000,000 lb. greater than that for 1889, and this, too, with a less number of fishermen and appliances.

The pike family (*Esocidæ*) furnishes a limited number of edible species which are taken with other fish in pounds and fyke-nets, to some little extent with trolling-gear, and in winter are caught through the ice on lines baited with minnows, or speared. The pike (*Esox lucius*) found in Europe, Asia, and North America, is the most abundant species, while in North America the pickerel (*Esox reticulatus*), and to a less extent the muskellunge (*E. nobilior*), come into market also.

The eels (*Anguillidæ*) comprise several locally important species, among them the great conger (*Conger conger*), a fish of rather wide distribution, which is taken, as on the coast of England, with hand-lines or with trawls. The common eel (*Anguilla rostrata*) is taken in great numbers, both in Europe and the U. S., by means of close wickerwork traps, made on the principle of a rat-trap, while on the New England coast many eels are caught with long-handled spears while hibernating in the mud. In European markets eels are customarily kept alive. Sweden has important eel-fisheries, those of Blekingen and Schonen literally netting $40,000 annually, and so has Italy, the eels being caught in the numerous lagoons along the coast. In the U. S. the catch of the eel-fisheries of the Atlantic coast amounts to about 3,500,000 lb., worth $223,323.

The swordfishes (*Xiphiidæ*), although large and good eating, whether fresh or salted, are, except in a few localities, not sufficiently abundant to be the objects of regular fisheries. On the New England coast, however, they are taken with the harpoon from small schooners, while on the coasts of Greece and Sicily they are pursued and harpooned from large row-boats or caught in strong gill-nets. The Italian boats have, or had, a long projecting figure-head, like the sword of the fish they seek for. The product of the New England fishery for 1889 was 1,230,339 lb., worth $55,242.

The representatives of the mackerel family (*Scombridæ*) are widely distributed in temperate and tropical waters, the most valuable species (*Scomber scombrus*) occurring in great shoals upon the coasts of Europe and eastern North America. Although in the U. S. the hook and line fishery for mackerel has practically given way to the big purse-seine, by means of which many barrels of fish are taken at a single haul, it is still carried on along the coast, and deserves at least a brief description. The peculiar hooks, known as "jigs," have the shank embedded in a cylindrical, tapering piece of lead, tin, or pewter, and are baited with strips of fresh mackerel. The fish are attracted to the surface of the water by throwing out quantities of finely ground menhaden, termed chum, whose oily portion spreads over the water, while the heavier particles sink. If hungry, the mackerel will follow up the chum, and are then attracted by the baits on the jigs and by the glitter of the jigs themselves. Each man has two lines, which are alternately thrown out and drawn in, the work when in a large school of hungry fish being very lively. Some mackerel are taken on the coast of the U. S. with gill-nets, and this mode of fishing is the one chiefly relied upon by European fishermen, the mackerel being taken like herrings by drift-net fishing. The train of nets employed often reaches the enormous distance of 2 miles. In Europe the catch of mackerel is little more than sufficient to supply the demand for the fresh fish, but in the U. S. a large proportion ot the catch is salted. England has mackerel-fisheries to the value of $853,835, and the figures for Ireland reach the sum of $1,062,745, but the Dominion of Canada leads with canned mackerel worth $19,917 and salt mackerel to the extent of $1,949,654 The mackerel-fishery of the U. S. is practically confined to the New England States, which in 1889 produced 3,074,441 lb. of fresh mackerel and 5,286,967 lb. of salt, worth respectively $256,550 and $474,874.

The huge tunny, horse-mackerel, or albacore (*Orcynnus thynnus*), which often attains a weight of half a ton, is taken in considerable numbers in the Mediterranean, chiefly along the shores of France, Spain, and Italy. It is also taken on the coast of Portugal and the Atlantic coast of France, while it is one of the most common and largely consumed fishes of Japan. On the Atlantic coast of the U. S. the tunny is frequently taken in weirs, but is deemed of comparatively small value, and was formerly usually thrown away. The catch for 1889 in New England amounted to but 74,000 lb., with a value of only $291. These figures are insignificant when compared with those for Portugal, which exports about 500,000 lb. of prepared tunny, worth over $57,000.

The bonitos, which belong in the mackerel family, are mostly deep-water fishes of warm seas, but they are taken in some numbers with hook and line, and combine with other species to swell the total of "miscellaneous fish." Nearly related to the mackerel are the crevalles (*Carangidæ*), among which is the delicious pompano (*Trachynotus goreensis*) of the West Indies and South Atlantic and Gulf States; these too are mostly caught with hook and line.

The Spanish mackerel (*Cybium maculatum*) occurs in the warmer waters on both sides of North America, and is highly esteemed as food; it is taken in seines, pounds, and gill-nets, and also to some extent with hook and line, and its relative, the kingfish (*Cybium regale*) of the Southern States and West Indian waters, is caught with trolling-gear.

The gray mullets (*Mugillidæ*), found in brackish waters or along the coasts in warm latitudes, furnish a number of important species, two of them (*Mugil albula* and *M. brasiliensis*), being of special importance in the Southern U. S., where great numbers are taken with cast-nets and seines. In Italy mullet-roes, salted and dried, are considered as delicacies, and this industry is being carried on to some extent in the U. S., the product for 1888 being 138,800 lb., worth $7,112. The catch of mullet for that year amounted to 9,752,107 lb., with a value of $227,798, more than two-thirds of this being credited to Florida. The fishermen of the Adriatic take mullet, like herrings, by "torching," the fish in their eagerness to reach the light actually leaping into the boats.

The bluefish (*Pomatomus saltatrix*), although widely distributed in the warm portions of the Atlantic and Indian Oceans, is of little commercial importance except on the coast of the U. S., where it has become very abundant. The bluefish is caught to a considerable extent in pounds and gill-nets, but probably more than half of the entire catch is taken on hand-lines by trolling from sail-boats. In 1888 13,416,389 lb. of bluefish were taken, having a value of $664,862, over half of this coming from New Jersey and New York.

The fresh-water bass and perch, contained in the families *Centrarchidæ* and *Percidæ*, are the objects of lake and river fisheries carried on largely by pound and fyke nets, and partly by seines and hand-lines. Among the more important species taken are the black bass (*Micropterus salmoides* and *M. dolomieu*), the grass bass (*Pomoxys sparoides*), the black gills (*Lepomis pallidus*), the yellow perch (*Perca fluviatilis*), common to both Europe and North America, the pike perch (*Stizostedium americanum*), and the European zander (*Lucioperca zandra*).

The sea-bass family (*Serranidæ*) includes such forms as the striped bass (*Roccus lineatus*), a well-known and important food-fish of the Atlantic coast of North America and its European ally, *Roccus labrax*, the white perch (*Morone americana*), taken abundantly in the estuaries of the eastern coast of the U. S. south of Cape Cod, and making up in numbers what it lacks in size, and the black sea bass (*Serranus atrarius*). In this family, too, are found the "groupers" of the Southern U. S., among them the huge jewfish (*Epinephelus nigritus*) and the guasa (*Promicrops guasa*), which respectively attain weights of 300 and 500 lb. The "groupers" are taken with hook and line on rocky reefs, and on the Florida coast are caught extensively for the Havana market. The fish are kept alive in wells, and at Key West and other ports are transferred to floating cars until wanted.

Closely related is the snapper family (*Sparidæ*), a group of marine fishes which includes the gamy and well-flavored red-snapper (*Lutjanus blackfordi*) and sheepshead (*Diplodus probatocephalus*). In 1888 the catch of the red-snapper amounted to 4,022,266 lb., worth $118,575. The other members of the group, although mostly small, are largely used for food. Among them are the snapper of Australia (*Pagrus unicolor*), an important food-fish, the sargo of the Mediterranean, and the sailor's choice (*Pomadasys fulvomaculatus*).

The true mullets (*Mullidæ*) are marine fishes of warm or tropical waters, whose most important member is the red-mullet of the Mediterranean (*Mullus barbatus*). The ancient Romans paid fabulous prices for this fish, and it is still considered a delicacy.

The drums (*Sciænidæ*) form an important family of edible fishes, including many large species, whose members with a single exception dwell in salt water and in warm regions. As they frequent rocky places, keep near the bottom, and, as a rule, do not go in shoals, they are mostly taken by hand-lines. The squeteague, or weakfish, or trout (*Cynoscion regale*), and sea trout (*Cynoscion maculatum*), of the Atlantic coast of the U. S., however, are largely taken in seines and weirs, and are valued not only for their flesh but for their sounds (swimming bladders), which furnish a fine quality of isinglass. The red-drum (*Sciænops ocellata*) is a valued fish of the Southern waters of the U. S., and the king-fish and whiting (*Menticorrus nebulosus* and *M. alburnus*), which are taken in nets, rank in flavor next the pompano and sheepshead. The catch of these two species amounted in 1889 to 12,146,000 lb., which brought $413,000.

The maigre (*Sciæna aquila*) and the corvo (*Umbrina cirrhosa*) are caught on the European coasts, the former occurring also at the Cape of Good Hope and on the coast of Southern Australia.

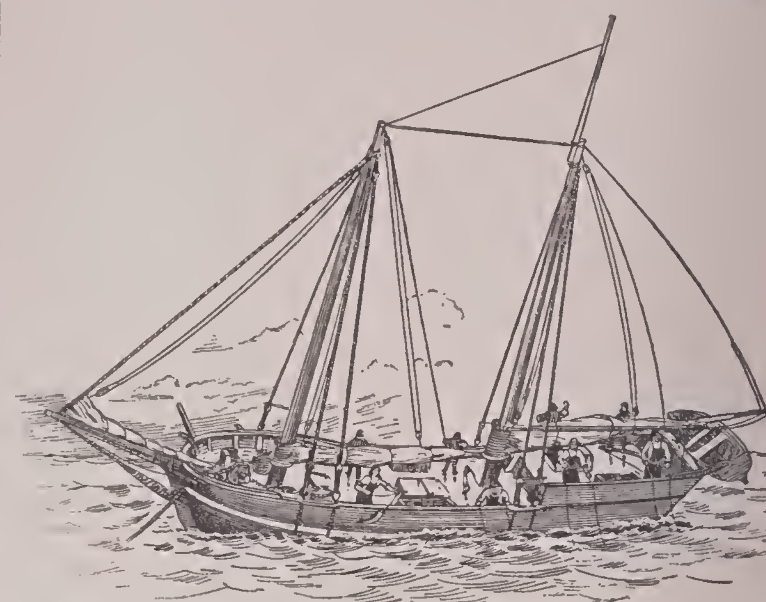
The wrasses or rockfishes (*Labridæ*) comprise nearly 500 species, mostly tropical, inhabiting rocky shores, where they feed on mollusks. Many of the species especially those brightly colored, are dry, but others, like the tautog or blackfish (*Tautoga onitis*) and cunner (*Ctenolabrus adspersus*), are excellent pan-fish. Of these two fish, well known along the New England coast, the catch for 1889 was reported at 557,195 lb. of tautog, worth $22,451, and 1,072,630 lb. of cunners, valued at $43,417. The scare of the Mediterranean (*Scarus cretensis*), the butterfish of New Zealand (*Coridodax pullus*), and the hogfish of the Gulf of Mexico (*Lachnolæmus falcatus*) are important forms. The parrot-fishes (*Pseudoscarus*) attain a considerable size, but unfortunately the flesh of these is sometimes poisonous. The rockfishes are largely taken with hand-lines, but the clap-net is also used to advantage in their capture, while in some localities pounds and gill-nets and occasionally seines may be used.

The rockfishes (*Scorpænidæ*) are residents of temperate or cold seas, often found at considerable depths, and are taken with hand-lines or trawls. The rosefish or Norway haddock (*Sebastes marinus*) is of considerable importance in Greenland and Northern Europe, and is also caught to some extent by fishermen of the British provinces and Northern New England. The group is particularly well represented in the North Pacific, between twenty and thirty species occurring on the northwest coast of North America, the rock-fish brought into San Francisco alone in 1888 amounting to 860,000 lb., with a retail value of $68,000.

The cultus cod (*Ophiodon elongatum*), a large fish reaching a weight of 30 or 40 lb., belonging to the allied group of *Chiridæ*, is an important fish of the North Pacific.

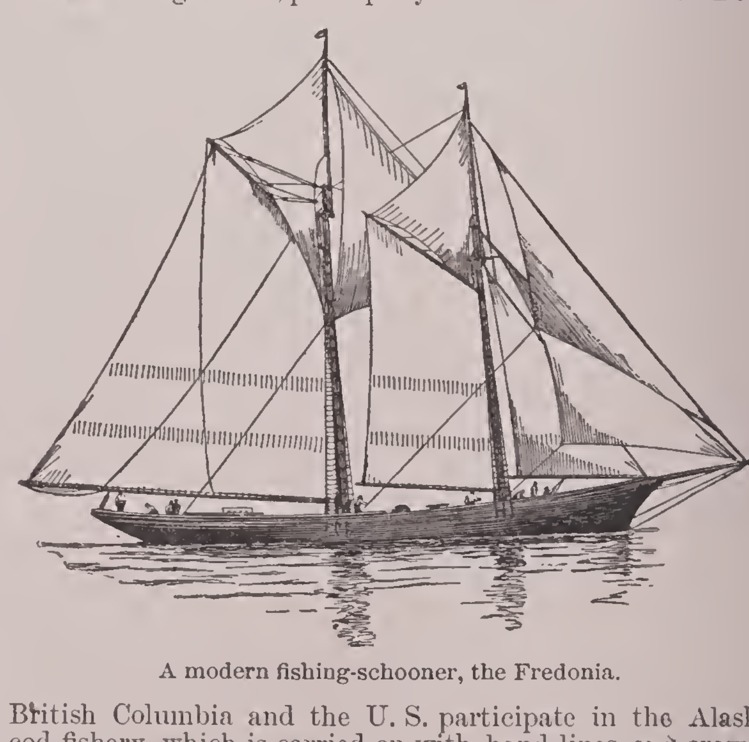
The cod family (*Gadidæ*), commercially the most important among fishes, is mainly confined to north temperate and arctic seas, being well represented both in the North Pacific and North Atlantic Oceans. Its leading member is the common codfish (*Gadus morrhua*), which has for centuries been the object of extensive fisheries along the northern shores of Europe and America, on the Grand Banks, near the Lofoden islands, and on the shoals of the German Ocean. The enterprise of the early fishermen is well shown by the fact that those of Normandy, Brittany, and the Basque Provinces visited Newfoundland in 1504, only seven years after the discovery of the island, while by 1578 not less than 400 sail of Spanish, French, and English vessels were engaged in the Newfoundland fisheries. The cod-fishery of eastern North America may be divided into the bank and inshore fisheries, the former being carried on by vessels of from 50 to 125 tons, and supplying the bulk of the salt fish, the latter being prosecuted from smaller craft, in some parts of the British provinces even from row-boats. In the British provinces the larger part of the fish taken inshore are salted, while on the coast of the U. S. the inshore fishery supplies a great part of the fresh fish for market.

Prior to 1860 the bank fishery was carried on by clumsy craft of 40 to 70 tons, and the fish were taken from the vessel, using salt clams or salt mackerel for bait. The schooners anchored on the banks, and remained in one place so long as fish bit well. Since 1860 larger and faster vessels have been introduced and trawls employed, or where hand-lines are used they are used from small flat-bottomed boats



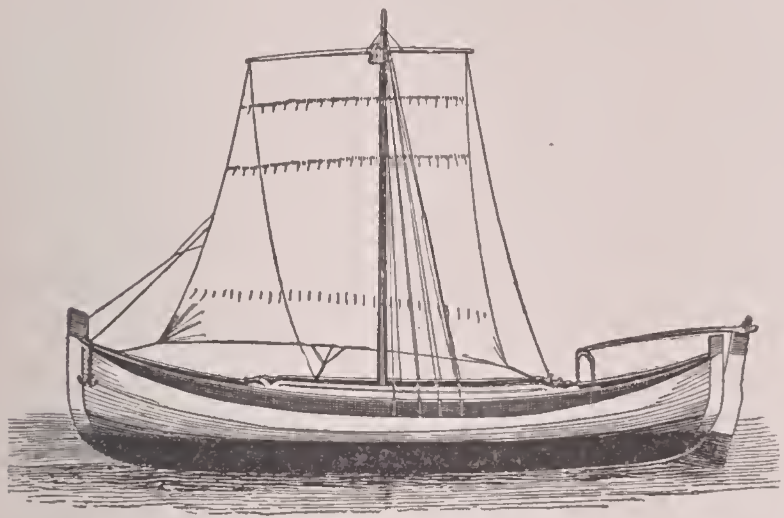
Bank fishing-vessel of the old type.

termed dories, which are eminently characteristic of the New England fisheries. Trawls are used in deep water, hand-lines where it is under 300 feet, and the bait is frozen herring, salt herring or mackerel, capelin, or squid, according to season. The fish are split, cleaned, and salted on board the fishing-schooners, the drying being done on the return of the vessel to a home port. The George's Bank cod-fishery is, in winter, one of the most hazardous of occupations, and is carried on by stanch schooners of 50 to 75 tons. The fish are taken with hand-lines, one to a man, directly from the vessel, and the gear is of the heaviest character on account of the rapid tides on the shoals. The line is steam tarred, 900 feet long, provided with two hooks and a lead weighing 8 or 9 lb. A considerable number of halibut are taken in connection with this fishery; these are packed in ice, but the cod are split and salted. Hand-lines and trawls are used in the inshore cod-fishery, and some cod are taken in gill-nets, principally when bait is scarce. Both



A modern fishing-schooner, the Fredonia.

British Columbia and the U. S. participate in the Alaska cod-fishery, which is carried on with hand-lines and trawls. This latter gear can not be used in some localities owing to the abundance of sea-fleas (*Amphipods*), which swarm over the bait and eat holes in the cod after they have been hooked. The cod-fisheries of Norway and Sweden are mainly carried on with hand-lines and gill-nets from large, open boats, and the catch per man is small when compared with that of the U. S. The fish are extensively dried, forming the stockfish of commerce. The English cod-fishery is peculiar in that the fish—taken with hand-lines or trawls—are to a great extent brought to market alive. This is effected by transferring the fish when caught to a "well," this being a portion of the vessel's hold, separated from the rest by transverse, water-tight partitions, to which water is freely admitted by holes in the bottom. A vessel thus provided is technically known as a smack.



Norwegian fishing-boat.

While the English fish are mostly used fresh a large portion of the catch of Scotland is dried.

France has important cod-fisheries about Newfoundland and Iceland, the former employing about 180 vessels and 7,200 men, the latter 240 vessels and 4,300 men. These fisheries have been looked upon as training-schools for the French navy, and are subsidized to the extent of 60,000,000 to 80,000,000 francs. Holland, too, carries on a cod-fishery, and many of the boats which are engaged in summer in catching herring are employed during the winter in taking cod on the Dogger Bank.

The value of fish taken by the countries most extensively engaged in the cod-fishery is as follows: Newfoundland (1891), \$5,092,623; Dominion of Canada (1890), \$3,827,708; U. S. (1889–90), \$2,760,000; France (1890), \$2,645,412; Great Britain (1887), \$1,853,197; Norway and Sweden, \$1,500,000; Holland (1886), \$291,600: total, \$17,970,540.

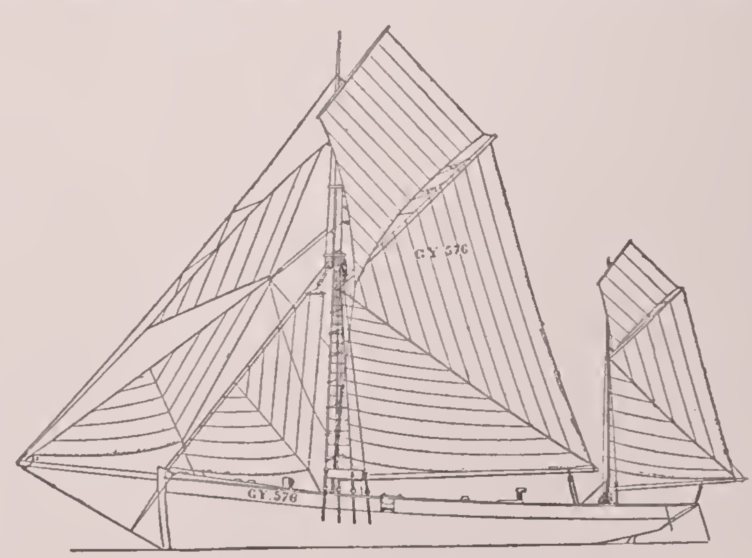
The haddock (*Melanogrammus æglefinus*), the hakes (*Phycis*), the cusk (*Brosmius brosme*), the pollack (*Pollachius carbonarius*), and the tomcod (*Gadus tomcodus*) are important food-fishes of the North Atlantic, while other allied species are found in the North Pacific. Some of these fishes, notably the hakes, are largely used in the manufacture of "boneless codfish," while the haddock produces the Scotch Finnan haddies (so-called from the town of Findon), which owe their flavor to the peat-smoke with which they are cured. The air-bladders of the cod and its relatives are salted as sounds, or made into isinglass, the tongues are looked upon as good eating, cod-liver oil is used according to its purity in medicine or in manufactures, and the skins yield a valuable quality of glue. The roes of some are used for bait, and have even been utilized as a source of albumen for the manufacture of sensitized paper. The importance of the so-called secondary products of the fisheries may be appreciated from the fact that one firm engaged in the manufacture of glues used in one year nearly 2,000 tons of fish waste, and produced about \$180,000 worth of material.

The family of flatfishes (*Pleuronectidæ*), from its wide distribution and the size and flavor of most of its members, is commercially an important one. The giant of the family is the halibut (*Hippoglossus vulgaris*), which not infrequently attains a weight of 250 lb., and is found in both the North Atlantic and North Pacific. It has been said of the halibut-fishery that "there is no other food-fishery in the world in which fish are sought at so great a depth," and this can easily be realized when it is stated that trawls are habitually set in water 600 to 1,200 feet deep, while halibut have even been taken at depths of 3,000 and 4,000 feet, three-quarters of a mile. The largest and fastest fishing-schooners are used in the fresh-halibut trade of the U. S., and the fish, which are taken on the outer slopes of George's Bank, the Grand Bank, and other noted grounds, are packed in ice and brought to market with all possible speed, sail being carried to the utmost, winter or summer. For the smoked-halibut trade, in which the fish are dressed and salted before being taken to home ports, schooners resort to the more distant portions of the Grand Banks, to the west coast of Greenland, and even to the distant shoals about Iceland. Halibut are continually becoming scarcer, and although they were formerly abundant in Massachusetts Bay and were regarded as a nuisance on George's Bank, it is now necessary, as stated above, to go long distances in search of them and to fish in deeper and deeper water. In spite of all exertions, the catch of halibut for 1889, by vessels from New England ports, although amounting to 10,740,843 lb., worth \$723,002, was nearly 4,000,000 lb. less than the catch for 1879. This loss was partly compensated for by the growth of the Pacific fishery, the State of Washington taking 1,220,000 lb.

The Greenland turbot (*Platysomatichthys hippoglossoides*) is a fine large fish which is brought to market in winter, in limited numbers, by vessels engaged in the frozen-herring trade, and another large species, the Monterey halibut (*Paralichthys californicus*), is an important food-fish on the Pacific coast of the U. S.

The numerous and smaller flatfishes, commonly known as plaice and flounders, found along the shores of the U. S., are taken by almost every kind of apparatus, the special sort employed depending on the local conditions under which the fishery is prosecuted. In Maine the majority are caught by haul-seines, while in Massachusetts pounds and trap-nets take the lead. Flounders are among the few fishes in whose capture spears play an important part, several hundred thousand pounds of these bottom-haunting fish falling victims to these instruments.

In European waters the turbot (*Rhombus maximus*) is held in high esteem, and is taken on hand-lines as well as by beam-trawls. This latter piece of apparatus is the chief means of capturing the various flatfishes of the North Sea, among them the justly celebrated sole (*Solea vulgaris*), a species not found on the North American coast. Great Britain leads in the beam-trawl fishery, the value of her catch being \$13,000,000, or between one-third and one-half the total product of all her fisheries. The bulk of the fish thus taken are naturally flatfishes, but whiting (*Gadus merlangus*), haddock, skate, and other species are caught in considerable numbers.



A Grimsby trawler.

The beam-trawl fishery is carried on mainly by stanch cutters and yawls of from 25 to 50 tons, but steamers of from 40 to 120 tons are also used and possess great advantages over sailing vessels, not only in towing the nets but in heaving them up. The task of hauling up the beam-trawl by hand-power is extremely laborious, and under the most favorable conditions takes from three-quarters of an hour to an hour, while in rough weather it may take even two or three hours. The steam trawler does the same work in from fifteen to thirty minutes. In order to avoid the loss of time that would be occasioned by each boat bringing home her catch steam carriers are employed which regularly collect the fish from the various vessels and transport them to market. France, Belgium, and Germany all participate in the beam-trawl fishery, and Holland, the originator of the apparatus, has quite a number of vessels so employed, among them some of the most peculiar craft that float. The low, sandy shores of the Netherlands call for vessels of light draft, while the lack of good harbors makes it desirable to have boats that can be drawn out on the beach. These conditions have given rise to the *bomschuit*, a stout, almost flat-bottomed craft, blunt at either end and more than half as broad as long, furnished with lee

A Dutch bomschuit.

boards and capable of being run on the beach and dragged out by oxen, to be dragged down again at low tide when wanted.

The flatfishes conclude the list of edible fishes, and it remains only to show some of the total results of the fisheries, and in the most general way to note some of the causes affecting them.

The following table shows the total value of the fisheries of some of the most important maritime nations, but it should be said that owing to the difficulty of gathering fishery statistics the figures can not be implicitly relied on. The reports of the U. S. and of France are very complete, but the returns for the Dominion of Canada and for Great Britain are avowedly incomplete in details. The official estimate of the fisheries of the United Kingdom for 1890 was £5,815,000 ($28,260,900). Dr. G. Brown Goode's estimate in 1883 was $40,000,000, and $32,000,000 is doubtless safe.

Total Value of Fisheries of all Kinds.

New England States	$8,133,600
Middle Atlantic States	10,550,640
Southern Atlantic States	11,601,760
Gulf States	2,438,675
Pacific States	6,387,805
Great Lakes	2,615,785
Other inland Fisheries	1,400,000
Total for U. S.	$43,128,265
Great Britain	$32,000,000
Japan	26,000,000
Russia	22,000,000
France	21,256,292
Dominion of Canada	18,977,878
Norway	8,000,000
Newfoundland	6,679,574
Portugal	3,400,000
Spain	2,500,000
Holland	2,225,000
Sweden	2,300,000
Italy	1,216,000

Dr. Goode's estimate of the total value of the fisheries of the world is $420,000,000.

The value assigned the fisheries of Japan seems high, but the Japanese both consume and export large quantities of fish, and not only carry on fisheries along their own coast, but along the adjacent shores of Asia, a fleet of some 4,000 boats being employed on the Korean coast alone, the annual catch being worth from $1,320,000 to $1,760,000. About 187,000 boats and over 1,500,000 people are said to be employed in the Japanese fisheries, but of this latter number only one-third are *bona fide* fishermen, the balance being engaged as helpers or in the preparation of fishery products.

China has vast fishing interests, and is extensively engaged in taking cuttlefishes, the city of Ningpo alone having 1,200 boats thus employed. It may be said, in passing, that cuttlefishes are coming into use in the U. S., and that there is a demand for them not only among the Chinese of the Pacific coast, but in the Eastern markets. The high rank of France is partly due to the extent of the subsidized cod-fisheries and partly to extensive and successful oyster cultivation.

Norway is peculiar from the fact that a comparatively small portion of the products of her fisheries is consumed at home, very nearly 80 per cent. being exported.

The fisheries of New Zealand and Australia are being rapidly developed, and, although confined to supplying the local markets, will undoubtedly attain considerable proportions. The Dutch East Indies have large local fisheries, Java and Madura counting about 50,000 fishermen, and the Philippine islands export great quantities of trepang (dried sea-cucumbers), pearl shells, and shark-fins, mainly to China.

The figures for the U. S. are smaller than they were ten years previous, partly owing to certain differences in the manner of tabulating the value of the products of the fisheries, and partly on account of a falling off in certain fisheries, notably in those for fur seals, whales, and mackerel. The returns from the New England and Southern Atlantic States are less than in the last decade, but other sections of the country have gained. Increase in the value of total catch does not, however, always indicate a desirable state of affairs, as it may be due to increase of apparatus, or to the taking of undersized fish, or those which have become marketable through the absence of larger or better species. The reports for the U. S. show that the percentage of increase in value of fish taken is proportionately much less than the increase in the amount of capital invested, although greater than the increase of men employed.

There is a steady growth in the value of the secondary products of the fisheries by the utilization of refuse in the manufacture of glue, oil, and fish guano, although unfortunately, and often unavoidably, large amounts of material still go to waste. Improved methods of transporting and handling fish, such as the use of steamers, fast-sailing vessels, refrigerator cars, and warehouses, have been important factors in the development of many fisheries, the one by speedily carrying the fish from their place of capture to the points of distribution, the other by keeping them in good order while in transit. The red-snapper furnishes a good illustration of these facts, for while in 1880 it brought $1 to $1.50 per lb. in New York markets, it can now be purchased for 15 cents. This is partly due to better knowledge of the fishing-grounds, but without facilities for transportation the catch could not have been utilized.

What the fisheries of the U. S. most need is not development but conservation. Halibut have grown scarce on the more accessible grounds; the supply of lobsters has in some localities dwindled; and the seemingly inexhaustible beds of oysters in Chesapeake Bay have become greatly depleted. The salmon has almost disappeared from the waters of the Eastern U. S., and, from the Potomac northward, the shad would have followed the salmon but for the efforts of the U. S. Fish Commission.

Anadromous fishes are often practically prevented by a multiplicity of nets from reaching their spawning-grounds; fishing is carried on at seasons when it should be prohibited; and fine-meshed nets are used which take fishes so young as to be of little or no value.

The erection of dams and the pollution of water by mines, manufactories, and sewage are other, and often preventible, causes for the decline or ruin of some fisheries.

Much of this might be remedied by good laws well enforced, but unhappily the fishermen who would be most benefited are too often bitterly opposed to any laws for the protection of fisheries, and they are carried on in a wasteful and destructive manner.

It is by fish-culture only that many of the fisheries of the U. S. can be preserved, and while its effects are most readily appreciable in lakes and rivers, there is good reason to believe that some coast fisheries, like those for lobsters and cod, may be sensibly benefited.

LITERATURE.—The various reports and bulletins of the U. S. Fish Commission contain a vast amount of information, including statistics relating principally to the fisheries of the U. S., but also contain many facts pertaining to those of other nations. The series of quarto volumes, *Fishery Industries of the United States*, prepared through the co-operation of the U. S. Commissioner of Fisheries and the Superintendent of the Tenth Census, forms an exhaustive treatise on the subject. The fisheries of Great Britain are discussed at some length by E. W. H. Holdsworth in the article *Fisheries*, in the last edition of the *Encyclopædia Britannica*, and under the captions *Fisheries* and *Fishery Treaties*, in Lalor's *Cyclopædia of Political Economy*, Dr. G. Brown Goode treats very fully the economical and political aspects of fisheries. Statistics for Great Britain may be found in various "blue-books," reports of inspectors and fishery boards for England and Wales, Scotland and Ireland, and these contain also much general information. The yearly *Fisheries Statements* of the Dominion of Canada contain the facts and figures for that vast region. *Statistique des Pêches Maritimes* is the title of the very comprehensive annual report of France, while the periodical *Circulare* and *Mittheilungen* of the Deutscher Fischerei Verein give much general information concerning not only the fisheries of Germany but of Northwestern Europe. The various reports, papers, and catalogues of the Berlin and London Fisheries Exhibitions of 1880 and 1883 are replete with interest, and *Bulletin 27* of the U. S. National Museum, which contains the catalogues of the collections of the U. S. exhibited at London, forms a comprehensive report on that section. For general reading may be recommended *American Fishes*, by G. Brown Goode; *Commercial Products of the Sea*, by P. L. Simmonds; *Fisheries of the Adriatic*, by George L. Faber; and *Deep Sea Fishing and Fishing Boats*, by E. W. H. Holdsworth. The catching of crabs, lobsters, seals, turtles, and whales, and the method of obtaining pearls and sponges, will be treated of under those heads. F. A. LUCAS.

Fisherman's Ring (in Lat. *annulus piscatorius*): a seal-ring worn by the pope, who with it seals certain briefs, which are said to be "given under the fisherman's ring." It bears a figure representing St. Peter fishing, is borne by the popes as St. Peter's successors, and has been used since the thirteenth century. The origin of this custom is not known. The habit, however, of wearing rings, either as token of authority (for instance, Pharaoh's ring), or as the token of a promise, a pledge (the wedding-ring), is extremely old. A ring similar to that worn by the pope belongs to the official costume of a Roman Catholic bishop.

Fishery Laws: the laws which define and regulate the rights of the public or of individuals to fish in natural or artificial bodies of water, public or private. The rules of the English common law regulating the subject of fisheries are of a twofold variety, since navigable waters—by which is meant, in legal usage, those in which the tide ebbs and flows—are distinguished, as regards the right to fish, from those which are not navigable. In streams above the reach of the tidal flow the soil to the center of the river-bed belongs to the riparian proprietors upon the opposite banks (see FILUM AQUÆ), and each of them possesses an exclusive right of fishery in that half of the stream over which his independent ownership exists. If the land upon both sides is vested in the same person, his fishing privilege pertains to the whole width of the river as far as the boundaries of his property along the course of the river may extend. But this exclusive right must be exercised so as not to interfere with the public convenience in passing along the stream in boats or rafts, and no dams or other obstructions can be made which would prevent the free passage of the fish, unless such privilege be given by statute. In navigable or tide waters, on the contrary, the soil is vested in the sovereign, and the right of fishery is common to the entire public. A special or exclusive privilege can only be created by legislative grant or by prescription, which must be clearly proved. This, however, is very unusual. This right of all persons to fish in public waters is called a *common fishery*. When several have a right to fish in a private stream in derogation of the owner of the soil, it is termed a *common of fishery* or *of piscary*. The designation *free fishery* is applied to an exclusive right in a navigable river arising by grant or prescription, without any right in the soil, while the term *several fishery* is employed when, in connection with such an exclusive grant, a property in the soil is also given. These various terms are, however, often employed without precision of meaning.

The doctrines of the English law concerning fisheries have been generally adopted in the U. S. In some few States, however, the common right of the public to take fish has been extended to streams ordinarily considered private, being above the flow of the tide. Thus in Pennsylvania and North and South Carolina it is declared that the great rivers of those States, even above tide-water limits, are subject to no exclusive privileges, but open to the general public. The regulation of fisheries by statutory provisions is very general, because great attention is given to the breeding of choice varieties of fish and the stocking of lakes and rivers. The modes and times of taking fish are often thus appointed, and penalties imposed for any violations of the restrictions created.

In the absence of any special statutory prohibition, it is supposed the inhabitants of one State may exercise the same right of fishing in the waters of another as the citizens of the latter possess. But the important question has come before a few of the courts for adjudication whether, if any State imposes upon the citizens of other States restrictions in regard to the power of fishing within its limits which are not imposed upon its own citizens, that clause of the U. S. Constitution is not violated which provides that "the citizens of each State shall be entitled to all the privileges and immunities of citizens in the several States." The U. S. Supreme Court has held, in opposition to some earlier cases, that the right of fishing is in the nature of a right of property incident to the right of territory, and that the legislation of any State appropriating it to the use of the citizens of that State, either exclusively or with the grant of peculiar privileges, would therefore not be unconstitutional. Compare *McCready* vs. *Virginia*, 4 Otto's Reports, 391; *Corfield* vs. *Coryell*, 4 Washington Circuit Court Reports, 380; *Bennett* vs. *Boggs*, Baldwin's Reports, 60; *The State* vs. *Medbury*, 3 Rhode Island Reports, 138; *Dunham* vs. *Lamphere*, 3 Gray's Reports, 276.

The U. S. Government at an early period adopted important measures of legislation to promote cod-fishing along the coast, providing for the payment of bounties to those persons who would engage in the business. Thus a law was passed in 1819 establishing the following bounties, which continued to be paid annually until the year 1866 to the owners of all vessels employed in the cod-fisheries for at least four months in the fishing season: For vessels between 5 and 30 tons, $3.50 per ton; for those above 30 tons, $4 per ton, except that the allowance to any vessel was not to exceed $360. But in 1866 fishing-bounties were abolished, and the only privilege now granted to the cod-fishermen is that duties shall be remitted on imported salt in bond which they take on board for curing purposes.

In the prosecution of the cod, mackerel, and other fisheries along the coast of Newfoundland and the other British possessions much hostility was created between British fishermen and those of the U. S. on account of the practices of the latter in fishing unlawfully in bays and inlets, and in drying and curing their fish upon British shores. The high seas are free and open to all nations, and people of any nationality may fish therein without restriction, but this right ceases at the mouths of rivers and in bays and harbors along the coast of any country, to the distance of a marine league from the shore. Foreigners can acquire a privilege to catch fish in places of this kind only by grant of the state or sovereign. At times the colonial authorities have used force to drive away U. S. fishermen from the Newfoundland and Canadian coasts. In order to remedy these difficulties, various treaties have from time to time been negotiated between the U. S. and Great Britain granting certain privileges reciprocally to the inhabitants of either country. For the provisions of these treaties, see FISHERY RELATIONS OF THE UNITED STATES.

GEORGE CHASE.

Fishery Relations of the United States: The right to catch fish on the high seas, on banks in the same, on the coasts, or in the bays and rivers of lands not pertaining to the jurisdiction of any organized state, is open to all; but by international law, as the sea for a marine league is under the jurisdiction of the sovereign of the adjoining land, no one can lawfully fish there without liberty expressly given or conceded by law or treaty. Much less has any one a right to dry and cure fish on the soil belonging to any organized state without permission.

In the treaty of 1783, by which Great Britain acknowledged the independence of those North American colonies which now form the U. S., the right of their inhabitants to take fish on the banks of Newfoundland was admitted, as well as in the Gulf of St. Lawrence and at all other places of the sea where they had been wont to fish in earlier times. *Liberty* also was conceded to them to take fish without drying or curing them on parts of the coast of Newfoundland used by British fishermen, and "on the coasts, bays, and creeks" of all other British dominions in America; and also to take, cure, and dry fish in any of the unsettled bays, harbors, and creeks of Nova Scotia, Magdalen islands, and Labrador, so long as they should remain unsettled, but to dry and cure fish after the settlement of such coasts, etc., "only with the consent of the inhabitants, proprietors, or possessors of the ground."

The treaty of Ghent (1815), terminating the war of 1812–15, said nothing of the right of fisheries. The U. S. Government claimed that the old treaty of 1783 survived the war, and the British Government denied such a claim, on the general principle that war dissolves ordinary provisions of treaties. In 1818 a convention made at London conceded to fishermen from the U. S. the right to take fish on the southwestern and western coasts of Newfoundland within certain limits, on the shores of the Magdalen islands, and on those of Labrador from Mt. Joly eastward and northward. The liberty of drying and of curing fish was confined to the southern coasts of Newfoundland and the coast of Labrador, as defined in the treaty, so long as they should continue unsettled, but afterward only with the consent of proprietors, as before. These grants were expressly made perpetual, and therefore suspended only, but not terminated, by war. On the other hand, the U. S. renounced for ever the right to take, cure, or dry fish within 3 marine miles of any coasts of the British dominions not named in the treaty. Liberty to enter bays or harbors thus excepted from the right of fishing was granted for purposes of shelter, repairing damages, and obtaining wood and water.

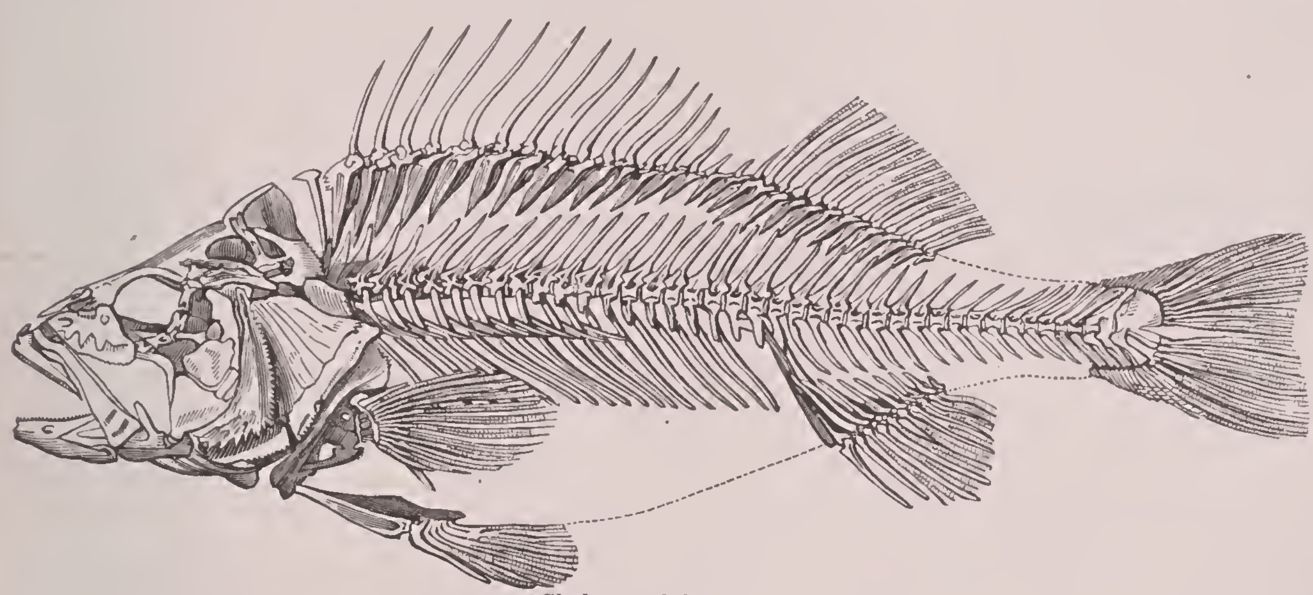
In 1854 a new treaty relating to the fisheries on the eastern coasts was negotiated, which went by the name of the Reciprocity Treaty, and considerably enlarged the liberties conceded to fishermen from the U. S. The rights created by the old treaty remained untouched and unenlarged; this treaty granted the additional right of taking fish, except shellfish, of every kind on the seacoasts and shores and in the bays, harbors, and creeks of Canada, New Brunswick, Nova Scotia, Prince Edward island, and of the islands thereto adjacent, and the permission of landing to dry their nets and cure fish on all these coasts, as well as on those of the Magdalen islands; provided it be done without interference with private property. From the permissions given by this treaty those of catching salmon and shad and of fishing in the mouths of rivers were excepted. On the other hand, similar liberties were given to British fishermen to fish along the shores of the U. S. as far S. as the 36th degree of latitude, with similar permission to dry and cure, and with the reservation of fisheries similar to those already mentioned. Other rights, such as the free navigation of Lake Michigan by both parties, and that of using the St. Lawrence within British territory, were provided for, as well as the free exportation of a number of its products by either country into the other. Among such products were lumber, coal, and fish, which latter was the chief equivalent for the free fishing granted the fishermen of the U. S.

This treaty, terminable after ten years on twelve months' notice, was actually terminated by the action of the U. S. Mar. 17, 1866, in pursuance of notice given a year before. Consequently, the treaty of 1818 alone regulated the fisheries on British American eastern coasts, and many irritating exercises of power and claims that the Americans had surpassed their rights occurred on the part of the authorities of the British dominions. Five years passed away before the treaty of Washington of 1871 put the fisheries on a new basis. In this treaty most of the particulars which enter into the intercourse of border states were considered, and form a system in which the advantages were intended to be equal. The fisheries were again placed substantially, as far as rights of fishing, curing, and drying were concerned, on the basis of the reciprocity treaty of 1854; only the southern limit of British rights of fishing, etc., along the coasts of the U. S. was moved northward to the 39th parallel. An important feature of the treaty was that of article 21, the admission of fish-oil and fish (except fish of inland waters and fish preserved in oil) into the territories of the U. S. from those of the Dominion of Canada and of Prince Edward island, being the produce of their fisheries, and *vice versa*, free of duty. Another provision of the treaty arose from the claim on the British American side that the concessions were of more value to the U. S. than to themselves. In order to determine this, article 23 provides for the appointment of commissioners to meet at Halifax and determine what gross sum, if any, ought to be paid to the British Government as a compensation for excess of advantages conceded to the U. S. Such a commission met at Halifax in 1877, and awarded $5,500,000 to Great Britain. This part of the treaty of Washington was by article 33 made terminable after ten years, and after one year's notice. Such notice was given in 1884, causing these treaty provisions to terminate on July 1, 1885. The treaty of 1818 has thus again come into force, and this has given rise to serious difficulties between the U. S. and Canada. An attempt in 1888 to settle this vexed question by a new treaty failed, owing to the non-concurrence of the Senate in the treaty proposed. It is probable that no form of reciprocity which balances the free entry of fish against the freedom of the inshore fisheries can be permanently satisfactory. For the conditions of the mackerel fishery, which is the one principally concerned, are constantly changing, and its importance accordingly fluctuates, while the free entry of Canadian fish is of constant value. The two are not proper equivalents. It is suggested, therefore, that a fair solution of the problem would be to secure through yearly licenses or outright purchase the fishery rights of the provincial shores for U. S. fishermen, and then settle the question of the free importation of Canadian fish on its own merits separately as a domestic matter. Until some such settlement is made difficulties will always arise.

Under the head of fishery relations with Great Britain should also be mentioned the sealing difficulty, the U. S. claiming the right to forbid all captures of seals in the Bering Sea, by any persons of whatever nationality, except the employees of a single company, under penalty of confiscation of ship and outfit. See BERING SEA CONTROVERSY. This claim was at first mainly based upon an exclusive jurisdiction over the eastern portion of the Bering Sea, which the U. S. was asserted to have derived from Russia with the Alaska purchase in 1867. Such exclusive jurisdiction was denied by Great Britain, since (1) the Bering Sea was part of the high seas, and since (2) Russia by formal treaty in 1824 with the U. S. and with Great Britain in 1825 had renounced the claim. It was also asserted that the U. S. had a property right in the seals accustomed to resort to its islands, and that their indiscriminate killing was *contra bonos mores*. As the sealskins are dressed in London, both countries have a sufficient reason for desiring the preservation of this animal, and toward the end of the first Cleveland administration an attempt at an amicable settlement was made to include several states and preserve the species threatened with extinction. This arrangement was prevented by the protests of Canada. Upon the failure of this plan, the Bering Sea was again patrolled by U. S. vessels, and pelagic sealing checked by force. At the same time negotiations were resumed which ended in an agreement to submit certain mooted points to arbitration, along with the question of proper international protection to the seals and rules therefor. This court of arbitration sat in 1893 at Paris. The main question before it was whether the U. S. on any ground possessed the *right* to prevent pelagic sealing in the Bering Sea exclusively; and also, if such protection could only arise by agreement with Great Britain, what rules were reasonable and necessary to make it effectual. The claim to an exclusive jurisdiction over a portion of the Bering Sea as being territorial waters of the U. S. was not strongly pressed by the counsel for the U. S., but the question of a property right in the seals resorting to the Pribyloff islands was very ingeniously and forcibly urged. The award, however, published in Aug., 1893, denied all the pretensions of the U. S. to prevent sealing in the Bering Sea as a matter of right. It denied any property right in the seals. It did more. It attempted to preserve the seal herd by prescribing rules to be binding upon and enforced by both nations which limit in time and place and method the pelagic seal-fishery. In brief, pelagic sealing is permitted only between Aug. 1 and May 1 to sailing vessels, using no nets or guns, and operating under license. It is forbidden the entire year throughout a zone of 60 miles around the Pribyloff islands. The regulations were applied not only to the Bering Sea, but also to the Pacific Ocean, east of 180°, from the latitude of a point two-thirds way down the coast of California northward to the Bering Straits. These rules may or may not be effectual. It should be remembered that they bind only subjects of the two nations which are parties to the agreement, and that owing to fogs, to the difficulty of guessing a ship's distance from the Pribyloffs, and to the organized systems of evasion which are sure to grow up, they may well fall short of absolute protection. Moreover, the question of damages for the seizure of sealers has not been taken up, though the liability of the U. S. is made clear by the award. But the main, the international, difficulty is settled. Revised by T. S. Woolsey.

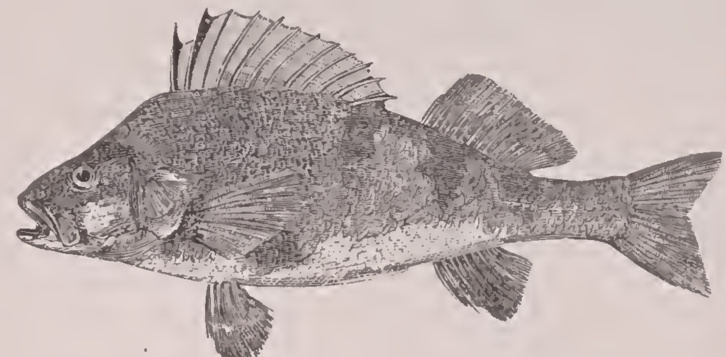
Fishes: a name applied, in a popular sense, to the vertebrated and all other inhabitants of the waters; in a scientific sense, restricted at first to vertebrates dwelling in water and inspiring air from it by means of branchiæ or gills, and later to a still more limited group, the lancelets, hagfishes, lampreys, sharks, and rays being assigned to separate classes, and not included among the true fishes. See Ichthyology.

General Characters.—Fishes, in the last acceptation of the term, may be defined as *lyriferous vertebrates, with a skull provided with membrane or dermal bones.* In these the shoulder-girdle forms a lyriform or furcula-shaped apparatus, like a bird's wish-bone, the scapular bones and their adjuncts of the two sides being connected below at the median line; an air-bladder (sometimes lung-like) is, as a rule, developed, and either connects with the œsophagus by a single duct (as in Ganoids and most soft-finned fishes), or is entirely closed (as in the spine-finned fishes); the skull is highly developed, and is provided with membranous bones, or with dermal shields which are homologous with them; the shoulder-girdle is formed, in great part, by large furcula-like bones, which bound the region behind the head, and which, beside meeting at the median line, are generally connected, by means of intervening bones, with the skull. These external scapular bones are also membrane or dermal bones, and are not developed in the Selachians; to their internal surfaces are attached smaller ones or cartilages (homologous with the shoulder-girdles of sharks), which support the pectoral fins.


Skeleton of the perch.

The gills and branchial apparatus are contained entirely within the cephalic cavity, in front of the scapular arch, and consist of five arches, the hindmost of which are, however, generally modified into pharyngeal bones; the gills are free at their distal margins. The brain is well developed, and has generally approximately equal cerebral and optic lobes and a moderate cerebellum. The heart is also well developed, and in all the forms (except some Dipnoi) is divided into an auricle and a ventricle. The members, anterior or pectoral, and posterior or ventral, whenever present, are developed as fins. In addition to these there are also generally median or unpaired fins sustained by rays (peculiar to lyriferous vertebrates), and of which the dorsal and anal are connected by the intervention of interspinal bones with the dorsal and inferior spines (neurapophyses and hæmapophyses) of the vertebral column; these fins are respectively termed dorsal, anal, and caudal. The caudal must by no means be confounded with the "tail" or "flukes" of the whales, which are to a certain extent homologous with the hind limbs.

Such are the characters which are common to all true fishes; that is, the classes Fishes and Ganoids of Agassiz,


European perch.

etc., embracing such forms as the flatfishes, codfishes, perches, mullets, billfishes, pikes, herrings, carps, electrical eels, mormyroids, catfishes, true eels, ganoids, etc. There is, however, much variation in other respects among these numerous constituents of the class. The skeleton may be bony or cartilaginous; the caudal, ventral, and even pectoral fins present or absent; scales, of very various character, present or absent; the air-bladder, either membranaceous or lung-like, present or absent; and, in fact, every portion of the framework and organization generally is liable to modification of some kind. The character and mode of association of some of these modifications may be best exhibited in connection with the systematic relations of the class.

In the typical fishes, known as teleosts, or bony fishes, the skeleton is ossified (whence the name); the optic nerves cross (decussate) each other; the heart has only two opposite valves, the outer elements of the scapular arch (proscapula) are simple, the inner elements are mostly ossified, and usually three or two in number; the pectoral member is destitute of any representatives of the humerus, and connected with the scapular arch by several (generally four) narrow bones (actinosts). To this great division belong by far the largest number of species and those most familiar; they are grouped in a number of orders, which have been named plectognaths, lophobranchiates, pediculates, hemibranchiates, teleocephals, scyphophores, nematognaths, apodes, and opisthomes.

In the remaining fishes, united by most recent naturalists under the name of ganoids, the skeleton is variable in its composition; the optic nerves do not cross, but are united by a commissure; the heart has a thickened bulbus arteriosus, provided with several rows of valves (but with those of each row sometimes united into a ridge, as in the lepidosirenids); the elements of the outer portions of the scapular arch (proscapula) are in some double, in others united; the inner scapular element is cartilaginous and simple; the pectoral member is provided with two basilar elements (bounding the insertion of the pectoral fin on each of its sides), or with a single pedicle corresponding with the humerus. The fishes combined under this last division, although not now numerous in species, exhibit extreme differences when compared with each other, and have been even considered (and with a very great degree of propriety) as constituting several subclasses. Commencing with those types which are most nearly related to the typical fishes, the characteristics may be briefly given and contrasted as follows:

In the first group (hyoganoids) the skeleton is ossified:

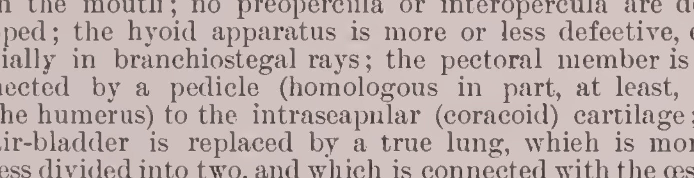
the skull also exhibits well-ossified bones; supramaxillary and intermaxillary bones are well developed; the nasal apertures are both external; preopercular and interopercular bones are present; the hyoid apparatus is well developed; the ceratohyals sustain a number of branchiostegal rays; the pectoral fin has two external cartilaginous basilar elements entirely separated from each other; and the air-bladder connects with the œsophagus by a duct which enters it from above. This group contains the orders *Cycloganoids* (represented in the U. S. by the bowfins or Amiids) and *Rhomboganoids* (represented by the alligator-gars or Lepidosteids).

In the second group (brachioganoids) the skeleton is also in great part ossified, but the centra or bodies of the vertebræ may be either osseous, or (in extinct types) represented by a persistent notochord; the skull is provided with well-ossified but superficial bones; supramaxillary and intermaxillary bones are distinguishable; the nasal apertures are external; preopercular and interopercular bones are both wanting; the hyoid apparatus is defective in the branchiostegal rays; the pectoral member is connected with and interposed at its base between two bones converging and uniting at their base with a cartilage representing a humerus; the air-bladder is highly cellular, and connects by its duct with the floor of the œsophagus. The group is represented in the present age of the earth by a single order (crossopterygians) with two genera (*Polypterus* and *Calamoichthys*), but was in ancient times rich in species.

In the third group (dipnoans) the skeleton is in part

Lepidosiren paradoxa.

ossified and in part cartilaginous, and the bodies of the vertebræ, instead of being ossified, are represented by a simple notochord; the skull is in great degree cartilaginous, but is also encased with superficial and thin membrane bones; no supramaxillary or intermaxillary bones are distinguishable; the posterior nasal apertures are internal, i. e. in the mouth; no preopercula or interopercula are developed; the hyoid apparatus is more or less defective, especially in branchiostegal rays; the pectoral member is connected by a pedicle (homologous in part, at least, with the humerus) to the intrascapular (coracoid) cartilage; the air-bladder is replaced by a true lung, which is more or less divided into two, and which is connected with the œsophagus by a duct or rudimentary trachea, which enters it from beneath. This type is represented at present by three very distinct genera—viz., *Lepidosiren* in South America, *Protopterus* in Africa, and *Ceratodus* in Australia, the members of this last genus being locally called *salmon* and *barramunda*. Formerly, the members of the group were among the principal representatives of the class, and in the Triassic period of Europe the *Ceratodus* of Australia was represented by several typical species of that genus, which was originally established on fossil dental plates.



The common sturgeon.

In the last group (chondroganoids) the skeleton is almost entirely cartilaginous (and from this circumstance the group has been named); this is the case especially with the vertebral column and its appendages; the skull is also cartilaginous, but is covered by dermal bones; no supramaxillary or intermaxillary bones are differentiated; the nasal apertures are external; both the preopercular and the interopercular elements are wanting; the hyoid apparatus, as in the last types, is defective in branchiostegal rays; the pectoral member, as in the Hyoganoids, has external cartilaginous basilar elements entirely distinct; and the air-bladder connects with the œsophagus by a duct which enters from above. To this group belong the sturgeons (constituting the order *Chondrostei*) and the "shovel-noses" or "paddle-fishes" of North America and Eastern Asia (constituting the order *Selachostomi*).

While the four groups just enumerated are the only great primary types of ganoid fishes that have members in the waters of the present epoch of the earth, in ancient times there were some very strange and peculiar forms which are not referable to any of those divisions, but which appear to stand isolated and afar from all others, and thus necessitate still another primary group. The types alluded to flourished among the first-known fishes, and in the Silurian and Devonian epochs. So strange are some of these in their appearance that remains of them have been referred to the crustaceans. Such are the forms which have been called *Cephalaspidæ*. Others (*Placoganoidea*) are almost equally aberrant in appearance, and their relations would not be suspected from their external characters; but the dental armature and scapular arches of a species discovered by Prof. Newberry in Ohio have convinced the writer that they were closely allied to the order *Sirenoidei*, and with them formed the super-order *Dipnoi*. The vomerine and palatine dental plates were contiguous, and seem to be homologous with the palatine plates of the *Sirenoidei*.

Limitations of Characters.—The student of the fishes, more than of any other class of vertebrates, must dissipate all prejudices with regard to the value of form in determining the relations of members of the class. Forms as diverse, almost, as any among all the quadruped mammals or among all the birds are found combined in the same natural family among fishes, and on the other hand there are forms that are very similar associated with structural characteristics that are very dissimilar. The student must also dismiss prejudices respecting the constancy of members (fins in fishes) in weighing their systematic relations. The members, for example, may vary in the same family, and ventral fins may be present or absent in closely related genera; scales are also by no means invariably characteristic of fishes, for they likewise may be present in one genus and absent in another in other respects very closely related. But although the presence or absence, *per se*, of parts may be comparatively immaterial, their structure, when present, is all important. The pectoral and ventral members, for example, are always constructed on the same *general* plan, and contrast markedly with those of the higher vertebrates. The character and mode of development of the scales, too, though not so distinctive as the fins, are *sui generis* in fishes.

Geographical Distribution.—About 9,000 species of living fishes are now known, variously distributed and found in greater or less numbers in almost all the waters of the globe, fresh and salt; the greatest numbers of species, however, are found in the tropical waters, and especially in the seas of the Indo-Moluccan Archipelago. The distribution of the types, especially of the marine species, to a considerable degree coincides with thermometrical conditions. In the polar and northern temperate regions, for example, are found representatives of the families of gadoids or codfishes, lycodoids, stichæoids, liparidoids, cottoids or sculpins, and others less known; in the tropical regions many forms are distributed throughout the entire zone (and therefore designated as tropicopolitan), this being especially the case with many genera of labroids (of which the tautog is a northern type), scaroids or parrot-fishes, pomacentroids, gerroids, serranoids or groupers, sparoids (of which the porgy is a representative), carangoids or horse-mackerel, and others; numerous species of these families being found in torrid waters, while very few extend far northward or southward. In the antarctic regions, again, there is another combination of forms; typical codfishes and the other types characteristic of high northern latitudes are wanting, but are replaced by several peculiar groups, which seem to fill an analogous place in the economy of nature, having a superficial resemblance in general aspect, although they are not at all (comparatively speaking) related in structure. The gadoids, for example, are replaced by notothenioids, the lycodoids by peculiar genera, the cottoids by harpagiferoids, etc. In the contrast between these antarctic and the arctic forms there is evidence of the absence of any paramount causal relation between temperature and structure; and it is necessary to remark here that, in addition to the tropicopolitan types, each great region has a number of characteristic and peculiar types.

But the distribution of the inhabitants of the great open seas and those of the inland waters is determined by different conditions, as might *a priori* be supposed. While, for example, the inhabitants of the opposite sides of converging continents are, to a great extent, similar, the fresh-water species of those continents are mostly quite dissimilar, the greatest difference being manifest in the most southern part of those continents.

There are numerous families of fishes which are represented in the fresh waters, some exclusively so, others with marine species. The geographical limitation and relation in space of these families may be exhibited under combinations in several categories—viz.:

(1) Peculiar to North America: *Centrarchidæ, Aphredoderidæ, Elassomidæ, Amblyopsidæ, Percopsidæ, Hyodontidæ*, and *Amiidæ*.

(2) Peculiar to tropical Asia: *Platypteridæ, Helostomidæ, Osphromenidæ, Nandidæ, Luciocephalidæ, Ophiocephalidæ, Notopteridæ, Salangidæ, Homalopteridæ*, and *Sisoridæ*.

(3) Peculiar to Africa: *Kneriidæ, Mormyridæ, Gymnarchidæ*, and *Polypteridæ*.

(4) Peculiar to tropical America: *Centropomidæ, Polycentridæ, Sternoptygidæ, Electrophoridæ, Hypophthalmidæ, Trichomycteridæ, Callichthyidæ, Argidæ, Loricariidæ*, and *Aspredinidæ*.

(5) Peculiar to Australia: *Gadopsidæ, Ceratodontidæ*.

(6) Peculiar and common to the cis-tropical hemisphere—that is, Northern America, Europe, and Northern Asia: *Gadidæ* (*Lotinæ*), *Cottidæ* (*Etheostomatinæ*), *Percidæ* (*Percinæ*), *Gasterosteidæ* (*Gasterosteinæ*), *Esocidæ, Umbridæ, Catastomidæ* (America and Eastern Asia), *Salmonidæ, Acipenseridæ*, and *Polyodontidæ* (America and Eastern Asia).

(7) Peculiar and common to Europe and Asia: *Cobitidæ*.

(8) Peculiar and common to South America and Australasia: *Percophididæ, Haplochitonidæ, Galaxiidæ*, and *Osteoglossidæ*.

(9) Peculiar and common to tropical and sub-tropical America and Africa: *Cichlidæ, Characinidæ*, and *Lepidosirenidæ*.

In addition to these, the family *Cyprinidæ* is represented in the entire cis-tropical or "arctogæan" hemisphere as well as in tropical Africa and Asia; and there are several monotypic families limited to very small regions, such as the *Comephoridæ*, the single species of which is only known from Lake Baikal. There are, further, a number of families (in addition to several already mentioned) which are chiefly represented by marine species, but which have also a greater or less number of representatives in fresh water in different regions of the earth: such are the *Brotulidæ, Blenniidæ, Gobiidæ, Atherinidæ, Mugilidæ, Cyprinodontidæ, Microstomidæ, Clupeidæ, Dorosomidæ*, etc.

Others, again, were represented in former epochs in parts of the world where they are not now found, and especially to be noted among these are two families characteristic in their distribution: the first of these is the *Cobitidæ*, which, in the early Tertiary, were inhabitants of Western America, and which thus increased the similarity of the fauna of the (cis-tropical) continent of North America with that of Northern Asia; the second is the *Ceratodontidæ*, a family whose representatives have been long known from fossil teeth found in Palæozoic and Mesozoic deposits (and which were referred by Prof. Agassiz to the sharks), and had been supposed to have expired toward the end of the Triassic epoch; yet since 1870 two species, closely allied to those found in the Triassic beds of Europe, have been discovered living in Australia; and thus another ancient type preserved in that continent illustrates the past life of North America.

If knowledge thus gained is applied to the appreciation of the different fish-faunas of the globe, the following conclusions are inevitable:

Inasmuch as the cis-tropical hemisphere shares in common the same families, and to a considerable extent the same genera, and even some species, it is presumable that the different regions of that hemisphere have derived their inhabitants from a common primitive source, although North America has quite a large proportion of forms peculiar to it. The relations of those peculiar forms, however, are in all cases rather with some found in the northern hemisphere (fresh-water or marine) than with any found elsewhere; but at the same time, toward the southwestern limits of the U. S., occur representatives of families which are characteristic of tropical America.

Tropical Asia also nourishes a number of peculiar forms, but the relations of those are either intimate with cis-tropical ones or with marine types.

Africa likewise has cyprinoids and anabantids in common with tropical Asia, and cyprinoids in common with the cis-tropical hemisphere, but it also supports several very peculiar families whose relations must be sought in other continents.

In tropical America are to be found the nearest relations of some of those African types, and several almost or quite limited to those two continents; on the other hand, in South America are found several families having no analogues in the parts of the world yet mentioned, but in Australasia are found representatives of not only the same families, but even, it has been contended, one of the same species. Under these circumstances one is almost compelled to believe that the first fauna of South America was derived, at a distant epoch, to some extent, from a common source with that of Africa and that of Australia. There are, however, at first sight contrary indications, but they are not irreconcilable; the most conspicuous and, as it were, obtrusive types of South American fishes are analogues of African forms, members of the families *Cichlidæ* and *Characinidæ*, but the species belong to widely different genera. On the other hand, although the types common to South America and Australia are not conspicuous in numbers or importance, they are much more nearly related to corresponding Australian species than the former, and, in common with other facts, somewhat tend to verify Huxley's views respecting an "Austro-Columbian" fauna.

In fine, dividing the earth into regions distinguished by general ichthyological peculiarities, several primary combinations may be recognized—viz.: (1) an *Arctogæan*, embracing Europe, Northern Asia, and Northern America; (2) an *Asiatic*, embracing the tropical portions of the continent; (3) an *African*, limited to the region S. and E. of the desert; (4) an *American*, embracing the America *par excellence* dedicated to Amerigo Vespucci, and including the tropical and trans-tropical portions; and (5) an *Australasian*. Further, of these (*a*) the first two have intimate relations to each other, and (*b*) the last three others among themselves; and some weighty arguments might be adduced to support a division of the faunas of the globe into two primary regions coinciding with the two combinations alluded to—(*a*) Pliogæa and (*b*) Eogæa.

Chronological History.—The earliest known remains of fishes occur in the lower Silurian of North America. The most ancient known fishes belonged to types entirely distinct from any that are in existence at the present time. As mentioned in the remarks on the primary groups of fishes, the Placoganoids, first of known fishes, heralded the advent of the class, and these were the predominant species apparently in the Devonian epoch; from somewhat later formations have been obtained the remains of representatives of orders still existing, but in very small numbers; such were especially the dipnoans, which were then represented by numerous genera and species; coeval with these were various Selachians or sharks. Almost all of the true fishes existing during the Mesozoic epoch have been referred to the great group of ganoids, but it is probable that some have been erroneously identified, and that they belonged to the subclass of teleosts. No universally recognized species of that group, however, have been found in deposits lower than the Cretaceous; in that epoch they began to culminate, and in time became the greatly prominent forms; and in the present epoch almost all the species (excluding the selachians) belong to this great group; and, so far as numbers go, all of the living ganoids might disappear, and yet the loss would scarcely be apparent in the sum-total of the class. Of about 9,000 existing species of fishes or teleostomes, less than 100 do not belong to the teleosts, and that number alone represents the various primary groups of the ganoid fishes, and yet, great as is the number of the teleostomes, and small as is that of the ganoids, the latter exhibit much greater differences in contrast with each other than do all the teleosts among themselves. Such is the character of the difference between the animals of the present and the distant past periods of the earth's history; and it is fortunate that, although with few lineal heirs left, most of the ancient types are still represented by some examples of their organization.

THEODORE GILL.

Fish-glue: a species of isinglass not sufficiently refined for culinary and medicinal purposes, but suitable for making cements, etc. It is prepared from the offal of the fisheries, and sometimes has a strong fishy odor.

Fish-hawk: a common name of the osprey (*Pandion haliaëtus*), one of the birds of prey, so called from its feeding upon fish which it captures by swooping down upon them when they are near the surface. The general color of the fish-hawk is vandyke brown above, the quill feathers are blackish, and the head, neck, and under parts are white. The outer toe, as in owls, can be turned backward and the powerful feet are furnished with sharp spicules which aid in holding the bird's slippery prey. The length is about 2 feet, the spread of wing 4½, and, as in most birds of prey, the female is larger than the male. By preference the fish-hawk nests in tall trees near the water. The nest, which is a bulky affair of sticks and weeds, repaired and added to yearly, is so large that small birds frequently build their nests in its interstices. The fish-hawk ranges over the greater portion of the warm and temperate parts of the globe, the American birds being frequently separated as a distinct geographical race or sub-species, *Pandion haliaëtus carolinensis.* The bird is systematically plundered by the bald eagle, and in some southern localities by the frigate bird. F. A. LUCAS.

Fish-hook: a curved, barbed, and pointed steel wire used in angling and the fisheries. The most important seats of the fish-hook manufacture are Limerick in Ireland and Redditch, Worcestershire, England, but fish-hooks of the best quality are made in the U. S., not inferior to those of Limerick except in reputation and cost. The Limerick hook has a barb which is forged solid and then filed into the proper shape, while the English and other ordinary hooks have a barb which is raised by cutting into the wire. These are inferior in temper and durability to the best hooks.

Fishing-bounties: bounties varying from $1 to $2.50 per ton, given during the period of British rule over North America to all vessels employed for the term of four months at least in each year on the Newfoundland Banks or other fisheries. Three-eighths of the bounty went to the owner of the vessel, and the remaining five-eighths to the fishermen. During the Revolutionary war this system fell out of use, but by act of Congress, 1792, it was re-established, on the ground that the state received great benefit from the fisheries as nurseries for seamen. Fishing-bounties were finally abolished in 1854.

Fishing-frog: See ANGLER.

Fishkill on the Hudson, or **Fishkill Landing**: village; Dutchess co., N. Y. (for location, see map of New York, ref. 6–J); on the N. Y. C. and H. R. and N. E. R. Rs., and on Hudson river, opposite Newburg, with which it is connected by steam ferry; 58 miles by rail N. of New York. It has three churches, an excellent public school, the De Garmo Institute, a hat-factory, machine and boiler shop, and an insecticide-factory. Pop. (1880) 2,503; (1890) 3,617; (1900) 3,673. EDITOR OF "FISHKILL STANDARD."

Fish-louse: a name applied to numerous parasites (generally entomostracous crustaceans of the order *Copepoda*) which infest fishes. The genera *Argulus*, *Caligus*, *Nicothoë*, *Dichelestium*, *Lernœodiscus*, *Chondracanthus*, *Achtheres*, *Anchorella*, and *Lerneotoma* are best known.

Fishmoth: See ENTOMOLOGY.

Fish-plates: a pair of plates placed upon opposite sides of a joint in a beam, and connected by bolts passing through the beam. The fish-joint for railway rails was first used in England in 1847, the plates being 18 inches long, 3 inches wide, three-fourths of an inch thick, and bolted through the rails by four bolts in oval holes, so as to allow for changes in length of the rails due to temperature. This joint is deficient in stiffness and has mostly passed out of use, the angle-bar joint having taken its place. See RAILWAYS.

Fisk, CLINTON BOWEN: soldier and politician; b. in Griggsville, N. Y., Dec. 8, 1828; became a merchant and banker at Coldwater, Mich.; entered the Union army in 1861 as a private, and became brevet major-general of volunteers in 1865. He devoted himself to the improvement of the colored race, was assistant commissioner in the Freedmen's Bureau, and founded the FISK UNIVERSITY (*q. v.*). He was a member of the Indian commission in 1873; held many other important offices; was a Republican until 1884, when he became a Prohibitionist. In 1886 he was a Prohibition candidate for Governor of New Jersey, and in 1888 the Prohibition nominee for President of the U. S. D. in New York city, July 9, 1890.

Fisk, WILBUR, D. D.: b. in Brattleboro, Vt., Aug. 31, 1792; joined in 1812 the sophomore class in the University of Vermont, but spent his senior year at Brown University, where he graduated with high honor in 1815. Entering with great zeal upon the study of the law, he was arrested in his course by what threatened to be a fatal illness, and in 1818 was licensed as a local preacher in the Methodist Episcopal Church. He soon took high rank as a pulpit orator. He was in 1825 chosen first principal of the Wilbraham Academy, Massachusetts, removing thither in 1826; in 1830 was chosen first president of the Wesleyan University, Middletown, Conn., and entered upon the duties of this office in 1831. He declined a bishopric in 1839. D. in Middletown, Vt., Feb. 22, 1839. He was a man of the Fénelon type of character. Published *Calvinistic Controversy* (New York, 1837); *Travels in Europe* (1838); *Sermons and Lectures on Universalism*, *Reply to Pierpont on the Atonement*, and other tracts and sermons. See his *Life* by Rev. Joseph Holdich, D. D. (1842) and by Prof. George Prentice (1890).

Fiske, JOHN, M. A., LL. D.: historian; b. in Hartford, Conn., Mar. 30, 1842; graduated at Harvard 1863; lecturer on philosophy 1869–71; instructor in history 1870; assistant librarian 1872–79, all in Harvard College; overseer of the same institution 1879–91; Professor of American History, Washington University, St. Louis, 1884. He was engaged mainly in lecturing and writing, making his home in Cambridge. His lectures and books were received with great favor not only in the U. S., but also in Great Britain. He also devoted himself to the exposition of Herbert Spencer's philosophy. His principal works are *Tobacco and Alcohol* (New York, 1868); *Myths and Myth-makers* (Boston, 1872); *Outlines of Cosmic Philosophy, Based on the Doctrine of Evolution* (2 vols., London, 1874; republished in Boston); *The Unseen World* (Boston, 1876); *Darwinism and other Essays* (London, 1879; new and enlarged edition, Boston, 1885); *Excursions of an Evolutionist* (Boston, 1883); *The Destiny of Man Viewed in the Light of his Origin* (Boston, 1884); *The Idea of God as Affected by Modern Knowledge* (Boston, 1885); *American Political Ideas Viewed from the Standpoint of Universal History* (New York, 1885); *The Critical Period of American History* (Boston, 1888); *The Beginnings of New England* (Boston, 1889); *The War of Independence*, for young people (Boston, 1889); *Civil Government in the United States* (Boston, 1890); *The American Revolution* (2 vols., Boston, 1891); *The Discovery of America* (2 vols., Boston, 1892); etc. D. July 4, 1901. C. H. THURBER.

Fisk University: an institution at Nashville, Tenn., for the education of colored persons of both sexes; founded in 1865 largely through the efforts of Gen. Clinton Bowen Fisk, for whom it is named. It has, besides the regular course of study in liberal arts, normal, industrial, and preparatory departments, and schools of theology and music. The original endowment was not large, but additions have been made from time to time, including a theological hall, which was completed in 1891, and the Fisk memorial chapel. The college is well attended by the colored race, and has done much for its advancement.

Fissirostres [Mod. Lat., from Lat. *fissus*, cleft + *rostrum*, beak, in allusion to the width of gape]: a term applied by Cuvier to a "tribe" of birds comprising the goat-suckers, swifts, and swallows, and so extended by G. R. Gray as to include the trogons, kingfishers, and a number of other wide-mouthed birds. The group, which was contrasted with *Dentirostres* and *Tenuirostres*, was purely artificial and the birds comprising it are now distributed in various orders. The adjective fissirostral, however, remains as a convenient term. F. A. LUCAS.

Fis'tula [Lat., reed, pipe, fistula]: in pathology, an abnormal canal, usually of small length and diameter, leading from one organ to another (vesico-vaginal fistula), or from some cavity of the body to the external world (gastric or biliary fistula, fistula in ano).

Fistula is called (1) complete, when it has two orifices; (2) incomplete or blind, when it has only one; (3) external, when the opening is through the skin; (4) internal, when it opens only into a cavity of the body. The two most prominent characteristics of a fistula are the constant discharge from it of a thin purulent fluid, with which the secretions of the organ affected are mixed, and the obstinacy with which it resists the healing process. This latter results from the nature of the wall of the fistula, which in recent cases is formed of soft, unhealthy granulation-cells which have no tendency to unite to form either cicatrix or cuticle. In older cases the walls consist principally of condensed connective tissue, inseparable from the surrounding parts. A fistula of long standing also exerts a change in the tissues through which it passes, these becoming more dense, and finally indurated, and the integument around its orifice callous and sometimes warty.

Fistula is caused (1) by wounds which penetrate passages giving natural exit to the secretions, or those which follow a long and deviating course through many tissues; (2) by ulceration and the sloughing process; (3) by abscess. The last is the most frequent cause.

The passage of a bullet through any region of the body sometimes leaves a canal which fails to unite; and whenever a necrosis of bone occurs there are usually one or more tracks following a winding course from it to the outside of the body. These passages are often called fistulæ, but the more appropriate name for them is *sinus*.

Fistula commonly occurs in persons of an enfeebled constitution. Where it results from abscess it is more frequently the chronic than the acute form which gives rise to it. Fistulæ were formerly supposed to furnish exit for morbid humors, and surgeons hesitated to attempt their cure. Some surgeons refuse to operate on a fistula in ano in a patient having phthisis, but this is evidently an error.

The cure of fistula depends upon producing union of its walls through the agency of healthy granulation-cells. This may be brought about by stimulating applications, as the injection of nitrate of silver, etc., in solution, or the application of the red-hot iron. Where the walls are old and indurated it is necessary to dissect them out and remove them altogether, bringing the lips of the wound together by sutures. The most common treatment consists in laying the fistula and soft parts above it freely open by an incision, and keeping the orifices of the wound apart, so that it may slowly heal by granulation from the bottom. There are other modes of cure, but they are less serviceable than the above, or else only applicable to special cases.

Revised by Roswell Park.

Fistula: the farrier's name for a deep-seated chronic abscess in horses, usually situated upon the withers, and discharging pus through fistulous pipes or sinuses. When seated upon the top of the head it is called poll-evil. Blows and strains of the tendon of the nape are the most fruitful causes of the disease, which most frequently attacks old or ill-kept animals. The thorough application of hot caustic solutions is often curative; but sometimes it is well to lay open the sinuses and retrench unhealthy masses of granulation-cells.

Fit: See Apoplexy, Convulsion, and Epilepsy.

Fitch: See Vetch.

Fitch [either abbrev. of *fitchet*, *fitchew*, polecat, or from O. Dutch *vitsche*, polecat, whence O. Fr. *fissian*]: the commercial name of the fur of the European polecat (*Putorius fœtidus*). It is collected in Northern Europe, and though in general inferior in quality to the fur of martens and sables, it is very handsome and serviceable, and when it is in fashion brings a good price. The animal which affords it is often called *fitchet*. See Polecat.

Fitch, John: inventor; b. in East Windsor, Conn., Jan. 21, 1743. In his twenty-sixth year he established himself at Trenton, N. J., as a silversmith. During the early part of the Revolutionary war he had large contracts for the repair of arms, but when the British army entered Trenton his shop and its contents were burned. He served as lieutenant in the New Jersey volunteers, and afterward resumed the business of repairing arms. Having procured an appointment as deputy surveyor for Virginia, he journeyed through a part of Kentucky, making surveys.

The thought of propelling vessels by steam, he claimed, originated with him in 1784. He matured his plans, and in Aug., 1785, petitioned Congress for aid in constructing his boat. In his statement before a committee appointed by the Assembly of Pennsylvania he averred that he had seven different plans and four different models of steamboats. The records of the American Philosophical Society of Philadelphia show that "a model, accompanied by a drawing and a description of a machine for working a boat against a stream by means of a steam-engine, was laid before the society by John Fitch on Sept. 27, 1785." With the pecuniary assistance of several gentlemen, Fitch immediately undertook to build a steamboat. The engine of Fitch was the first double-acting condensing engine, transmitting power by means of cranks, ever constructed.

On May 1, 1787, Fitch's steamboat, the Perseverance, was put in motion on the Delaware river, and made 3 miles per hour. Improvements were made, and the steamboat, with its greatly increased power, was successfully tested in the fall of 1788. With thirty passengers the vessel left Philadelphia and, moving against the current of the Delaware, reached Burlington, a distance of 20 miles, in three hours and ten minutes. Subsequently the Perseverance made 80 miles in one day.

Fitch was sent to France by the steamboat company, under the auspices of Consul Aaron Vail, who was anxious to have a steamboat built in that country; but finding all the machinists engaged on Government work, Mr. Vail furnished Fitch with means to return to his native country. He crossed the British Channel, and during his stay in London, in 1793, he published his pamphlet entitled *An Explanation for Keeping a Ship's Traverse at Sea by the Columbian Ready Reckoner*. He returned to Boston in 1794 in a state of destitution. From that time to 1796 he resided at Sharon, Conn. In the *Documentary History of New York*, vol. ii., p. 585, will be found an interesting account of experiments subsequently made by Fitch in propelling a small boat by steam on the Collect Pond, formerly existing in the lower part of the city of New York. This boat was arranged with side wheels, and a screw propeller at the stern. In 1797 Fitch went to Kentucky to obtain possession of lands he had purchased there. D. at Bardstown, Ky., July 2, 1798. See the *Life* by Westcott (1857).

Fitch, John Lee: See the Appendix.

Fitch, Ralph: one of the first English travelers in India; lived in the latter half of the sixteenth century. He was a merchant dealing in East Indian products, and it was for the purpose of advancing his business that he undertook the great voyage (1583–91), crossing from Tripoli to Bagdad, sailing from Bagdad to Ormus, and visiting both Indies and Ceylon. A description of his tour (*The Voyage of Mr. Ralph Fitch*) is found in Pinkerton's *Collection of Travels*.

Fitch, Simon Walbrooke: surgeon; b. in Horton, Nova Scotia, Jan. 2, 1820; graduated M. A. at Acadia College, Nova Scotia, and M. D. at Edinburgh University in 1841. He began practice in St. John, New Brunswick, in 1842; removed to Portland, Me., in 1855; to New York city in 1874; and afterward to Halifax, Nova Scotia, where he became consulting surgeon of the Victoria General Hospital. He was surgeon to the Fifth Corps Military Hospital, Fredericksburg, Va.; surgeon to the troops at Fort Preble, Me.; is a member of the council of Edinburgh University; and connected with various medical societies in Europe and America. He invented the dome trocar, the dome transfuser, and dome aspirator needle in 1875, the clamp cyst forceps in 1876, the trocar prostate catheter in 1882, the intra-uterine forceps in 1886, the handy aspirator in 1887, and at different times other surgical and gynecological instruments. Among his published works are *Lithotomy* (1858); *Excision of Uterine Tumors* (1862); *Medical and Surgical Practice in Great Britain* (1872); *Paracentesis, Aspiration, and Transfusion* (1886). Neil Macdonald.

Fitch, Thomas: Governor of Connecticut; b. in Norwalk, Conn., in June, 1699; graduated at Yale College 1721; practiced law, and filled the offices of counselor, judge of the Supreme Court, chief justice (1750–54), Lieutenant-Governor, and Governor. In 1766 he was driven into retirement for having taken the oath of office prescribed in the Stamp Act in 1765. D. in Norwalk, July 18, 1774.

Fitchburg: city and railway center; one of the capitals of Worcester co., Mass. (for location, see map of Massachusetts, ref. 3–F); situated on a branch of Nashua river, 25 miles N. of Worcester, the other county-seat. It has fine churches and schools, a public library, three parks, extensive manufactories, excellent water-works, sewers, street railways, and electric lights. The census of the U. S. for 1890 showed 285 industrial establishments, with a capital of $6,120,050, giving employment to 4,195 persons at an annual wage of $2,268,221. The cost of materials was $5,381,910; the value of products, $9,349,993. Among the leading industries are the manufactures of paper, machinery, woolen goods, ginghams, cotton yarns, and bicycles. Pop. (1880) 12,429; (1890) 22,037; (1900) 31,531. Editor of "Sentinel."

Fitzgerald, Augustus Frederick: third Duke of Leinster; b. in London, Aug. 31, 1791; succeeded to the title on the death of his father in 1804, and took his seat in the House of Lords; in 1831 was appointed lord-lieutenant of the County Clare in Ireland, and member of the queen's privy council. Was the grand master of the order of Freemasons in Ireland. For many years he was the sole Irish duke, and he also held the rank of first marquis and earl among the Irish nobility. In politics he was a Liberal, but conservative on the question of a repeal of the union with England. In 1818 the duke married the daughter of the Earl of Harrington, by whom he had four children. D. in London, Oct. 10, 1874. His eldest son, known as the Marquis of Kildare, succeeded to the dukedom, but died in 1887, and was succeeded by Gerald Fitzgerald.

The Fitzgerald family of Ireland is a very ancient Anglo-Norman one, long thoroughly Hibernicized, and derives its descent from the Barons of Offaly, first ennobled in 1205. In 1747 the family was elevated to the British peerage, and in 1766 the then head of the family was created Duke of Leinster.

Fitzgerald, Edward: author; b. at Bredfield House, near Woodbridge, Suffolk, England, 1809; d. 1883. He was educated at Trinity College, Cambridge, and spent his life mostly in his native county in study and literary pursuits. He made translations from Æschylus, Sophocles, and Calderon, and published a selection from the writings of his father-in-law, Bernard Barton, the Quaker poet. His fame rests, however, on his translation (1859) of the *Rubáiyát* (quatrains) of the Persian poet Omar Khayyam, which went through many editions and achieved a remarkable success. Fitzgerald's *Letters and Literary Remains* (3 vols.) were published in London in 1889. H. A. Beers.

Fitzgerald, Edward: a bishop of the Roman Catholic Church; b. in Limerick, Ireland, 1833. He removed to the U. S. in 1849; was educated at the College of the Barrens, Missouri, and at Mt. St. Mary's College, Emmettsburg; ordained priest in 1857; and in charge of a parish in Columbus, O., till 1867, when he was consecrated Bishop of Little Rock, Ark. While in Columbus he restored harmony between his parishioners and the Archbishop of Cincinnati, on which his church was relieved of an ecclesiastical interdict; and in Arkansas he promoted immigration to the State, and introduced several orders of brothers and sisters to conduct missionary, educational, and charitable work. He took part in the Vatican Council in Rome 1869–70, and in the Third Plenary Council in Baltimore 1884.

Fitz Gerald, James Newbury, D. D., LL. D.: a bishop of the Methodist Episcopal Church; b. in Newark, N. J., July 27, 1837. He was educated and fitted for the profession of law, and was from 1858 to 1862 an attorney and counselor. He entered the ministry in the Newark conference in 1862, and was pastor, or presiding elder, until 1880. He was recording secretary of the missionary society 1880–88, and elected bishop in 1888.

Fitzgerald, Rt. Hon. John David, P. C., Q. C., LL. D.: b. in Dublin in 1816; educated at Trinity College, Dublin: called to the bar in 1838, and became a Q. C. in 1847. In 1855–56 was solicitor-general of Ireland, and in 1856–58 and in 1859–60 attorney-general. In the House of Commons he represented Ennis from July, 1852, to Feb., 1860, and was then made a judge of the court of queen's bench in Ireland, where he was a commissioner of national education, of charitable donations and bequests, and of endowed schools. In 1856 he became a privy councilor. D. Oct. 16, 1889.

Fitzgerald, Oscar Penn, D. D.: a bishop of the Methodist Episcopal Church South; b. in Caswell co., N. C., Aug. 24, 1820; educated at Oak Grove Academy, Rockingham co., N. C.; held successively the positions of pastor, editor, college president, and superintendent of public instruction in California. He was elected bishop in 1890, and resides at Atlanta, Ga. He has published a number of books, including *California Sketches* (2 vols., 1879–81); *Christian Growth* (1883); *Centenary Cameos* (1884); *Bible Nights* (1888); *Judge Longstreet: a Life Sketch* (1891).

Fitzgerald, William, D. D.: Anglican Bishop; b. in Lifford, Limerick, Ireland, Dec. 3, 1814, and educated at Trinity College, Dublin; B. A. 1835. In 1840 he wrote in opposition to *The Tracts for the Times.* In 1847 was appointed Professor of Moral Philosophy in Trinity College, and in 1852 Professor of Ecclesiastical History. He edited *Constable's Ethics* and *Butler's Analogy*, and was author of one of the answers to *Essays and Reviews.* He was joint editor of *The Irish Church Journal* with Dr. Abeltshauser, was consecrated to the see of Cork in 1857, and transferred to that of Killaloe, Kilfenora, Clonfert, and Kilmacduagh, in 1862. D. at Clarisford House, Killaloe, Nov. 24, 1883.

Fitzmaurice, Henry Charles Petty: See Lansdowne.

Fitzpatrick, Charles: See the Appendix.

Fitzpatrick, John Bernard, D. D.: b. of Irish parents, in Boston, Mass., Nov. 1, 1812; educated at Boston, at the College of Montreal, and the Sulpitian Seminary, Paris. In 1840 he was ordained a Roman Catholic priest; in 1844 was consecrated coadjutor bishop of Boston; and in 1846 succeeded Bishop Fenwick in the bishopric. D. Feb. 13, 1866.

Fitzroy, Robert: British naval officer; b. at Amton Hall, Suffolk, July 5, 1805. He entered the navy in 1819, and in 1828 was placed in command of the Beagle brig, then engaged in surveying the coasts of Patagonia under Capt. King of the Adventure. The ships returned to England in 1830; in 1831 Fitzroy was commissioned to continue the surveys in the Beagle, Charles Robert Darwin (*q. v.*) going with him as naturalist. The cruise lasted until Oct., 1836, and included thorough surveys of the southern and western coasts of South America, and the running of a chronometric line around the globe. In 1837 Fitzroy received the gold medal of the Royal Geographical Society. In 1839 he published his *Narrative of the Surveying Voyages of H. M. Ships Adventure and Beagle* (3 vols., 8vo; the 3d vol. by Darwin). In 1841 Fitzroy was elected to Parliament; he was governor of New Zealand 1843 to 1845, and superintendent of the Woolwich dockyard 1846 to 1849. In 1850 he retired from active service. In 1851 he was elected to the Royal Society, and in 1854 was appointed chief of the meteorological department of the Board of Trade. D. in London, Apr. 30, 1865. Besides the *Narrative* referred to, he published several well-known works on navigation and meteorology, *Barometer Manual* (1861), and *Weather-book* (1863), and was practically the founder of the modern weather-signal service. Herbert H. Smith.

Fitzsim'mons, Thomas: b. in Ireland in 1741; became a merchant in Philadelphia, Pa., and commanded a volunteer company in the Revolutionary war; was for many years a member of the Pennsylvania Assembly; in 1782–83 delegate to the Continental Congress; in 1787 to the Federal constitutional convention; and 1789–95 member of Congress. D. in Philadelphia, Pa., Aug., 1811.

Fiume, fi-oo'mā: free imperial city of Hungary; on the coast of the Adriatic, at the mouth of the Fiumara, where it falls into the Gulf of Quarnero; 40 miles S. E. of Trieste (see map of Austria-Hungary, ref. 8–D). It is an important seaport; has large ship-building industry, and manufactures of paper, machinery, tobacco, etc. The harbor is excellent and the quay admirable. The exports and imports are considerable. Pop. (1890) 29,001.

Five Forks, Battle of: a battle between the Union forces under Gen. Sheridan and the Confederates under Gen. Pickett, fought in Dinwiddie co., Va., Apr. 1, 1865.

Gen. Grant, extending his left around the right of Lee's line near Petersburg, advanced the Fifth Corps (Warren) and the cavalry under Sheridan to the vicinity of Five Forks. Warren on Mar. 31 struck the right of the enemy's line on the White Oak Road, where, supported by Humphreys, he fought the action of White Oak Ridge with a loss of about 1,400 killed, wounded, and missing from his corps. Sheridan's advance, moving farther to the left, met a superior force near Five Forks, and was driven back to Dinwiddie Court-house.

On Apr. 1 Sheridan was placed in command of the movement, and having connected his forces with Warren's he decided to attack the left (east) flank of the Confederate position at Five Forks, overlap their line, strike their rear, and thus cut them off from the rest of the army, while the cavalry was to strike their front and right flank so soon as the infantry was fully engaged. The attack was made at about 4 P. M. and was carried out as planned; but, owing to the exact position and shape of the Confederate line not being known, some confusion arose in one of Warren's divisions, and the direction of the march of the other two had to be changed. The necessary steps were taken under the personal direction of Gens. Sheridan and Warren; the Confederate left wing was enveloped by the infantry, the cavalry attacked in front at the same time, and the Confederate line was rolled back from its intrenchments and completely routed, with the loss of a number of prisoners, estimated by different authorities from 2,600 to 4,500, together with six guns and thirteen colors. The number of killed and wounded is not exactly known, but was probably about 600. On the Union side the chief losses were those of the Fifth Corps, and amounted in killed and wounded to 634. An unfortunate controversy between Gens. Sheridan and Warren led to the latter being relieved from command immediately after the battle. On the next morning (Apr. 2) the final successful assault upon the lines at Petersburg was undertaken. A detailed description of this action, together with a *résumé* of the points involved in the controversy mentioned, is given in *The Virginia Campaigns of 1864 and 1865*, Humphreys, Scribner's War Series. See also the *Battles and Leaders of the Civil War*. JAMES MERCUR.

Five Islands: the northern end of the Philippine Archipelago. See BABUYAN.

Five Islands: post-village of Colchester co., Nova Scotia; on the Basin of Minas (for location of county, see map of Quebec, etc., ref. 2–B). It has considerable mineral wealth and manufactures of baryta paint, which is an imitation of white lead, and carries on ship-building. Here there is a cataract with a fall of 90 feet. Pop. 1,000.

Fixed Air: a name given by Dr. Black to CARBONIC ACID (*q. v.*). That this gas was liberated in the burning of lime was known to Van Helmont, who called it *gas sylvestre*, but Dr. Black's name came into more general use. Fixed air is properly carbon dioxide, CO_2.

Fixed Oils: See OILS.

Fixed Stars: See STARS.

Fixing: See PHOTOGRAPHY.

Fixtures [formed from *fixure* (either by analogy of *fixed* or of words in which, as is usually the case, the suffix *-ure* is preceded by *-t-*) from Low Lat. *fixu'ra*, a fastening, deriv. of *fi'gere*, *fixum*, fix, fasten]: things which, in themselves being personal property, have been annexed to or made accessory to real estate. There has been a bewildering variety of legal definitions given to the term, and it is hardly possible to fix upon any which would reconcile their various discrepancies and receive general acceptation; but the one here stated will probably make as near an approximation to accuracy and completeness as any that have been suggested. Annexations of this nature, when made under certain conditions and circumstances, still continue to be considered chattels, while in a different class of cases they are regarded as constituting a part of the realty, merely as a result of the change that has been effected in their situation and relations. Two structures identical in every respect, not only in construction, but also in the manner of their attachment to a house or land and in the uses to which they are applied, may be treated in law at one time as personalty, at another as realty; and as the rules as to management and disposition would be essentially diverse in the two cases, and additions to real property are very common for purposes of improvement, trade or manufacture, agriculture, etc., the "law of fixtures" is manifestly of great importance. The subtlety of the distinctions resorted to makes the subject one of exceptional intricacy, and has been the cause of much conflict in the decisions.

The question to be determined in every instance is, Has an addition to land become itself real property? It was formerly a well-established legal principle that such a result was consequent upon every case of attachment, and the rule was stated in a concise Latin maxim, as if universally applicable (*quicquid plantatur solo, solo cedit*—whatever is affixed to the soil belongs to the soil—i. e. becomes a part of it), but the exceptions which have been established have become so numerous that the formerly received doctrine, though still applicable as a general principle relating to fixtures, can no longer be regarded as of much practical value. In the elucidation of the subject the primary and fundamental inquiry must be whether there has been a true annexation in the legal meaning of the term. This annexation may either be *actual*, as where there is some real substantial attachment to land or buildings, or it may be merely *constructive*, as in cases where, though there is apparently no connection, and the articles are easily portable or removable, they are yet properly considered as appurtenant to certain real property and indispensable to its integrity. Thus machinery attached to buildings, furnaces, mirrors fastened to walls, etc., would be illustrations of actual fixtures, while door-keys, window-blinds, or bells temporarily detached, fences that have been removed but are to be replaced, etc., would constitute *constructive* fixtures. Such articles as the latter kind are, by common consent and necessarily, considered essential to the complete idea of a dwelling or a plot of land, as being requisite for its ordinary and proper use. But if, on the one hand, things originally chattels have been completely incorporated into real property, as where boards are fashioned into floors or plaster wrought into walls, or, on the other hand, chattels are merely suffered to rest upon land or lie within buildings, but are not naturally considered as essential thereto, no difficulty can arise as to whether the articles are real or personal. They are real in the former instances, and personal in the latter, beyond any possibility of doubt.

After the subject of annexation has been considered, another leading inquiry is the presumable intention with which the erections or additions were made, and by the establishment of what principles the requirements of a wise and judicious public policy would best be promoted. As the standard of "public policy" is necessarily very indefinite and general, it might be expected that the conclusions to be derived from its application would be largely determined by the more specific inquiry as to "intention," if the results which the latter afforded were entirely consistent with public welfare; and such seems to have been the case, since the rules referred to both these criteria mainly coincide. One test, however, serves to supplement and modify the other. In examining into the intent with which fixtures were erected, the actual purpose is not so much in question as the reasonably and justly *presumable* intention which the law can gather from all the attendant circumstances and the relations of the parties concerned to have been the instigating and guiding motive. When, for instance, a person sells land with certain additions upon it of the equivocal nature of fixtures, and which the purchaser may naturally have presumed to pass with the grant, and to have been intended for the permanent improvement of the property, the law will not permit the vendor to claim that his actual intent, though secretly indulged, was to consider the articles as personalty and remove them for his own use. An intent is fastened upon his conscience which his acts fairly and justly warranted, and which alone is consistent with any understanding which the opposite party could have formed under the circumstances. The dictates of public policy also support the same rule, since otherwise fraud could be readily committed, and free transfers of property would be hampered by suspicion and uncertainty. But if a vendor's actual intention is made known to the purchaser at the time of sale in regard to additions strictly within the class of fixtures, or if a chattel mortgage has been made in regard to them, which the purchaser can ascertain, presumed intent will coincide with actual intent, and the relations of the parties will be determined accordingly. Again, when additions for purposes of trade are made upon leased property by a tenant for years, it is necessarily presumable that he does not intend that they shall be permanent attachments, but that he only purposes their maintenance during the time of his tenancy. Considerations of public policy also support this conclusion, since the establishment of a prohibition upon tenants to erect fixtures which they could remove when their interests expired would materially interfere with the leasing of property and with commercial enterprise and progress. In all cases, however, in which specific contracts are made, or persons have a clear understanding of the terms upon which their interests are created, no opportunity for presumption can exist, and if the agreements be legal public policy can interpose no obstacle. The parties may determine upon what stipulations they will.

On these grounds has been made a division of the parties in regard to whom questions concerning fixtures most generally arise into two great classes: (*a*) One class consists of those interested in property on which fixtures have been erected by one having a *permanent* interest therein; (*b*) the second class is where the fixtures were annexed by one having only a *limited* interest in the land. Under the first class questions arise (1) between heir and executor of one adding fixtures to land; (2) between mortgagor and mortgagee of property on which fixtures had been erected by the former; (3) between vendor and vendee of land with fixtures thereon; (4) between vendor and contractor to buy land under similar circumstances. Under the second class questions occur (1) between landlord and tenant where the latter erects fixtures after the commencement of his lease; and (2) between tenant for life and remainder-man or reversioner. When the interests of all those varieties of parties grouped under the first class are concerned, the presumption is quite rigid that attachments to the land constitute a part of it, and consequently are governed by all the rules appertaining to real estate. Fixtures, therefore, which the law would presume to have been attached for permanent continuance will pass to heirs rather than to executors, will be conveyed under a deed or mortgage of the property to the vendee or mortgagee, or will be included within the contract of one who agrees to purchase the land. But a large number of annexations may, even in this class of instances, be considered as personal property, for those additions, as has been stated, are alone treated as realty in regard to which the legal presumption is that they were added for the *permanent improvement and habitual enjoyment* of the premises. In order to determine whether such a presumption can justly be entertained regard is had to a variety of tests, as, for instance, to the nature of the annexation, whether bulky and unwieldy or light and easily removable; to the adaptability of the attachment to the proper and natural use of the building in which it is placed, or of the land with which it is connected; and to many diverse considerations which must evidently depend upon the circumstances of each particular case. If a building were erected in such a location and with such peculiarities of construction that it could only be used to advantage by the employment of certain machinery which had been placed within it, or could be adapted to different purposes only at great expense, the deduction would be necessarily made that such machinery was intended to be no mere temporary attachment, but that it was designed for permanence.

One test of considerable importance and frequent application is to consider the manner in which the fixture is joined to or connected with the property to which it is attached—whether it can be removed without injury to the premises, or whether its fastenings can be readily detached. This was formerly said to be the chief distinguishing test in all questions concerning fixtures, the statement being made that all objects firmly fastened were real property, while those not so annexed remained chattels; but this rule would exclude all constructive fixtures from the category of realty, and can not be upheld. The criterion is only valuable as indicative of intention to have the articles remain constant attachments to the land. But it is so indefinite and general in its character, and leaves so much room for fine-drawn distinctions and delicate subtleties of discrimination whose reasonableness is oftentimes difficult to discern, that to this cause alone is attributable much of the confusion in the legal decisions upon the subject of fixtures. Thus machinery attached to a building by means of rods passing through joists and there secured by nuts has been held to be real estate, while looms merely fastened to the floor by screws have been considered personalty. Some courts have gone so far as to hold that articles fastened by bolts or nails would become realty, when if fastened by screws they would still remain chattels, since screws can be so much more readily removed that it is natural to believe that in the latter case a removal was intended. Other courts deny the distinction. In regard to such objects as stoves, boilers, kettles, and various articles of machinery of moderate size, the cases have exhibited much discrepancy. Buildings erected upon wooden blocks merely are generally considered chattels. A statue resting upon a pedestal in the garden of a dwelling-house has been decided to be real property as between a mortgagor and a mortgagee, as probably erected for permanent continuance. The rolling-stock of railroads is by some courts considered real, by others personal property, in perplexing variety. As between mortgagor and mortgagee the decisions preponderate that it may be treated as real estate. But by a decision rendered in New York it has been held to be personal property (*Hoyle* vs. *Plattsburg and Montreal Railroad Company*, 54 New York 314 [1873]).

But it would be useless to multiply illustrations; only the general principle can be satisfactorily stated. The common law rule is that trade-fixtures, in regard to the rights of those classes of persons that have hitherto been considered, are not to be treated differently from fixtures of other kinds, but in the relations of landlord and tenant it will be seen that they attain to great importance.

In regard to the rights of those persons forming the second class above mentioned—viz., landlord and tenant and tenant for life and remainder-man—the law concerning fixtures is very different. Both the question of presumed intent and the dictates of public policy, as has been seen, lead to conclusions essentially diverse from those which have been stated as applying to other cases. But the doctrine of presumed intention is not carried so far as to permit a tenant to erect anything he may choose upon his landlord's premises, with the privilege of removing it when his tenancy is ended, since the landlord's interests, which are equally deserving of protection, might be unduly sacrificed. The tenant therefore may only take away additions he has made when they belong to one of these special classes. (1) He may remove all fixtures which he has erected for purposes of trade or manufacture. This rule is established to promote business enterprise. Thus brewing-vessels, cider-mills, closets, shop-counters, engines, presses, etc., may all be rightfully removed. The rule has also been extended to buildings constructed by the tenant for purposes of trade, as, e. g., additions to an inn, tavern-keeping being deemed a species of trade. The removal must be made by the tenant so as not to injure the landlord's premises. (2) In the U. S. the general rule is established that fixtures annexed for agricultural purposes may be removed. In England a contrary rule was maintained at common law, but some exceptions have been established by statute. Nursery trees would be an illustration of agricultural fixtures. (3) Articles erected for domestic use and convenience and the necessary enjoyment of the premises are, in general, removable. This privilege probably would not extend to objects of mere ornament. In any case, it is necessary that the tenant should exercise his right of removal before the expiration of his interest and his yielding up possession, as otherwise he will be deemed to have abandoned the fixtures to his landlord. But the executor of a tenant for life, as the necessity of the case demands, has a reasonable time after the tenant's death to take away the fixtures.

The rights of landlord and tenant may be variously modified by mutual agreement. They may contract to consider certain articles chattels which would otherwise become real estate according to general rules, and *vice versa*. It is quite common to find a provision in leases that the fixtures at the end of the term shall be taken by the landlord at a valuation made in a specified manner; as, e. g., by appraisers selected by the parties. By such an agreement matters which, legally speaking, would be real estate may be made to appertain so far to the tenant as to entitle him to compensation. Consult Amos and Ferard on *Fixtures*; Washburne on *Real Property*; Chitty on *Contracts*, etc.

George Chase.

Flac'cus: a cognomen of several Roman families, of which the most important belonged to the gentes Fulvia, Valeria, and Pomponia. The poet Horace (*q. v.*) also bore this name. Among the illustrious men of the name were (1) Lucius Valerius Flaccus, consul with C. Marius in 100 b. c., censor in 97, and again consul in 86 b. c., when he was murdered by Fimbria. (2) Q. Fulvius Flaccus, consul 237, 224, and 212 b. c., often prætor, and distinguished in the Second Punic and many other wars, in which he was fortunate; but his character is stained by his cruel treatment of the Campanians. His family produced many public men, among whom his son, Q. Fulvius Flaccus (d. 173 b. c.), and his grandson, M. Fulvius Flaccus, were the most renowned. The former was a distinguished general in Spain; the latter, a partisan of the Gracchi, was put to death 121 b. c.

Flaccus, Gaius Valerius: an epic poet who flourished in the reign of Vespasian. He is not to be confused with Martial's poet-friend Flaccus, a native of Padua. The name given in the Vatican manuscript (C. Valerius Flaccus Balbus Setinus) makes it probable that he was born at Setia. He died in the reign of Domitian, probably about a. d. 89, and Quintilian speaks of his death as a loss to literature. He was the author of a poem entitled *Argonautica*, on the expedition of the Argonauts, in imitation of the poem of Apollonius of Rhodes, which extended to eight books, but was left unfinished. His style is an imitation of that of Vergil, but more declamatory and artificial. He often produces obscurity by the use of involved constructions and too crowded figures, and too frequently and on too slight occasions calls in the aid of the gods. The best editions are those of Burmann (Utrecht, 1702; Leyden, 1724); J. A. Wagner (Göttingen, 1805, 2 vols.); G. Thilo (Halle, 1863); and C. Schenkl (Berlin, 1871). Revised by M. Warren.

Flaccus, Siculus: a writer on land-surveying, who lived probably soon after the reign of Nerva. Nothing is known of his life. His extant work, *De Condicionibus Agrorum*, in its present form refers only to Italy, and is full of legal learning and valuable information. It is included in Lachmann's edition of the *Gromatici* (Berlin, 1848–52).

Revised by M. Warren.

Flaccus, Marcus Verrius: a freedman by birth, distinguished as a grammarian and teacher at Rome under Au-

GREECE. *Merchant, same as war without Crown.*
BULGARIA. *Merchant_red.*
ITALY. *Merchant, same without Crown.*

MEXICO. *Merchant, same as war without Coat of Arms.*
DOMINICAN REPUBLIC. *War same as Merchant except Coat of Arms in centre.*
HAITI. *War has white square in centre containing Coat of Arms.*

FLAGS OF VAR

US NATIONS.

ARGENTINE. *Merchant, same without Sun.*
COSTA RICA. *Merchant, same without Coat of Arms.*
BELGIUM. *Merchant, same without Coat of Arms.*

MOROCCO. *Merchant, plain red*
TUNIS. *Merchant, plain red.*
PERU. *Merchant, same without Coat of Arms.*

gustus. He was so successful in his method of instruction that the emperor placed his own grandsons under his charge, and allowed him to bring his other pupils into the Palatium, on the condition that no additions should be made to their number. At his death, under Tiberius, a statue was erected to him in the forum at Præneste. He was the author of several works, historical, antiquarian, and grammatical, the most important of which, and the one the loss of which is most deplored, was entitled *De Verborum Significatu*. This is referred to occasionally by later grammarians, and a few extracts from it (and the other writings of Flaccus) have been collected by O. Mueller in his edition of *Festus* (see *Præfatio*, p. xiii.), but it was superseded in general use by the abridgment of Festus, which no doubt caused the final disappearance of the larger treatise. (See FESTUS, SEXTUS POMPEIUS.) A brief notice of Flaccus is given by Suetonius in his *De Grammaticis et Rhetoribus*. See also Nettleship's articles entitled *Verrius Flaccus* in *Am. Journal of Philology*, vol. i., pp. 253–76, and ii., 1–19.

Revised by M. WARREN.

Fla'cius, MATTHIAS (surnamed ILLYRICUS): scholar and polemic; "the Achilles of pure Lutheranism," of the second generation of the era of the Reformation; b. at Albona, in Venetian Illyria (hence *Illyricus*), Mar. 3, 1520. His right name was Vlacich Francowitz. He desired to become a monk, but was dissuaded by Lupetinus, provincial of the Minorites, who put into his hands some of Luther's writings and counseled him to study theology in Germany. He went to Basel 1539; became private teacher at Tübingen 1540; went to Wittenberg 1541. Out of great spiritual darkness and distress, connected with his views of election, he was led by Luther, of whose faith he became one of the most earnest defenders. He received the chair of Hebrew 1544; in 1545 he married; in 1549 the Schmalcald war compelled him to leave Wittenberg. In the time of theological conflict on the Adiaphora which followed the INTERIMS (*q. v.*), Flacius took a position of uncompromising fidelity to the principles of Luther, which Melanchthon and his school were periling by indecision. He was a defender of the faith against open enemies and misjudging friends. (See OSIANDER, MAJOR, SCHWENKFELD, and SYNERGISM.) In Magdeburg he began (1557) his immortal church history, the *Magdeburg Centuries*, in which he was the main worker, though he had a body of able colaborers, among whom were Wigand, Judex, Faber, and Nicholas Amsdorf. Brischar, a Catholic divine, says: "It is impossible to ignore the erudition, the acuteness, and the gift of combination which express themselves in this book." The *Catalogus testium Veritatis* (1556) was meant to trace in a long line of witnesses the evangelical protest of the ages against the errors of Rome. In the same interest he published the *Missa Latina* (1557), a copy from a missal of about A. D. 700. In 1558 he was appointed a professor in the newly founded University of Jena; but in 1561 he was dismissed for his resistance to the encroachments of the state on the liberties of the Church. His whole after-life was one of wandering and suffering, amid which he finished his other great works, the *Clavis Scripturæ Sacræ* (1567) and his *Glossa on the New Testament*. He died in the hospital at Frankfort, Mar. 11, 1575, at the age of fifty-five, having displayed a tenacious courage, mostly for the truth, not unlike that of Luther. "He was," says Kling, "a man of faith, one of that cloud of witnesses of whom the world was not worthy." A lack of metaphysical accuracy in the use of language—which, however, he finally modified—involved him in a controversy which arose from his assertion that ORIGINAL SIN (*q. v.*) is a substance, and not accidental. This view, called "Flacianism," was condemned, in the strict sense of its phraseology. (See CONCORD, FORMULA OF.) Its adherents were styled Flacians and Substantialists. See the *Life* by A. Twesten (vindicating Flacius; Berlin, 1844), and that by W. Preger (the best; 2 vols., Erlangen, 1859–61).

Flad, HENRY: civil engineer; b. in Bavaria in 1823; graduated at the University of Munich in 1846. From 1849 to 1861 he was engaged in railway construction, mostly on the Ohio and Mississippi Railroad. He served in the civil war (1861–65), enlisting as a private and being promoted to the rank of colonel. Since 1865 he has been actively engaged on many civil engineering works, among which may be mentioned the water-supply of St. Louis, the arch bridge over the Mississippi at St. Louis, and the large park on the western border of that city. He has been president of the board of public improvements of St. Louis for many years; during 1886 he was the president of the American Society of Civil Engineers, and in 1892 he was one of the members of the Mississippi River Commission.

Flag [M. Eng. *flegge*, from Dan. *flæg*, flag. Perhaps akin to *flag*, droop]: any one of various long-leaved aquatic plants, such as sweet-flag (*Acorus calamus*), blue-flag (*Iris*), and cat-tail flag (*Typha*).

Flag [prob. from Dutch *vlag* < O. Dutch *vlagghe* (perhaps deriv. of *vlaggheren*, flag, droop): Dan. *flag*: Germ. *Flagge*]: an ensign. Webster defines *flag*, as "that which *flags* or hangs down loosely," "an ensign or colors"; a cloth usually bearing certain devices and attached to a staff; it is synonymous with the French *drapeau*. It is, in fact, one of the forms of *insignia* by which nationality is distinguished—by which the sway or jurisdiction of a political power is asserted. Hence its predominating use in those organizations of a country by which its sovereignty and jurisdiction are asserted and maintained—i. e. the army and navy. Hence, too, its powerful appeal to the patriotism of all those who see in it the symbol not only of their country's power, but of its claim upon themselves. Pendent over a fortress or ship, and throwing out, with the varying breeze, its folds to the four quarters of the heavens, it seems to hold above them the imperial ægis of a nation's power. A history of such "insignia" would occupy volumes. The Chinese flags or banners are said to have been, in essentially their present forms, in existence at a date earlier than the siege of Troy. The term "vexillum" of the Romans applies to anything that is *borne as an ensign*, whether it be a flag or banner, or some other device; but it became specifically applied to the *drapeau à croix* (i. e. a flag suspended to a horizontal cross-piece, attached by cords to the upright staff, with which arrangement the term "banner" has become identified) after the time when the Emperor Constantine introduced the LABARUM (*q. v.*); and this form of flag has been used ever since by the Church. It is also the most usual form of the banners of lay societies.

During the early days of the Revolution in North America the colonists made use of flags of various devices; the first legally established national emblem was that adopted by Congress June 14, 1777, which provided that the flag of the thirteen United States should be thirteen stripes, alternately red and white; that the union be thirteen stars, white in a blue field, representing a new constellation: this form was altered by act of Jan. 13, 1794, which provided that after May 1, 1795, the flag of the U. S. should consist of fifteen stripes, etc., and fifteen stars, etc.; in 1818, however, act of Apr. 4, the flag was re-established as thirteen horizontal stripes, alternately red and white; the union to consist of twenty stars, white, in a blue field; one star to be added to the union on the admission of every new State; the addition to be made on the fourth day of July succeeding such admission. This flag was first used July 4, 1818, and is still the recognized national emblem of the U. S. of America.

In the U. S. army the garrison flag is the national flag, 36 × 20 feet; the post flag is 20 × 10 feet; and the storm flag 8 feet by 4 ft. 2 in., used also as a recruiting flag. The colors of the engineer battalions consist of a national flag 6 ft. 6 in. by 6 feet, with the words U. S. Engineers embroidered in silver on the center stripe, and a battalion color of the same size, scarlet, having in the center a castle with the letters U. S. above, and the word Engineers below, all embroidered in silver. Fringe white, cords and tassels red and white silk intermixed. Each artillery regiment has two silken colors—the first, the national emblem, 6 ft. 6 in. fly and 6 feet deep on the pike; the number and name of the regiment embroidered with yellow silk on the center stripe. The second, or regimental color, is of scarlet, of same dimensions as the first, bearing in the center two cannon crossed, with the letters U. S. above and number of regiment below, both in scarlet in a yellow scroll. Fringe yellow, cords and tassels yellow and red intermixed. Infantry regiments have likewise two colors of silk and of similar size—the first of which is the national flag, with the number and name of the regiment in white silk on the center stripe; the regimental color is of blue, with the arms of the U. S. embroidered in silk on the center; the number and name of the regiment embroidered in white in a red scroll underneath the eagle. Fringe yellow, cord and tassels blue and white intermixed. Each mounted regiment has a yellow silken standard 4 × 3 feet, bearing the arms of the

U. S. embroidered in silk, with the number and name of the regiment embroidered in yellow in a red scroll underneath the eagle. Each company has a swallow-tailed silken guidon 3 ft. 5 in. × 2 ft. 3 in., half red, half white, divided at the fork, the red above: on the red the number of the regiment in white, and on the white the letter of the company in red.

The hospital and ambulance flags are of white bunting 9 × 5 feet, 6 × 4 feet, and 28 × 16 inches, with a cross of red bunting in the center; the arms of the cross are of equal length. Camp colors are national colors, as described for garrison flags, printed upon bunting 18 × 20 inches, mounted on an ash pole 8 feet long, armed at its butt with a pointed ferrule so that it may be easily driven in the ground.

The supreme royal standard of the United Kingdom of Great Britain and Ireland was hoisted for the first time on the Tower of London Jan. 1, 1801. It is a square flag or banner on which are emblazoned the arms of England, Scotland, and Ireland, the field of the first and fourth quarters being red, the second yellow, and the third blue. This flag is displayed over the residence of the sovereign or any other member of the royal family, as well as on certain fortresses and stations throughout the empire on state occasions or royal anniversaries, and is hoisted at the masthead of any vessel on which a member of the royal family is embarked. The second or admiralty flag in the British navy bears an anchor and cable on a red ground, and characterizes the presence on board ship of the lord high admiral or the lords commissioners of the admiralty. It came into use during the reign of Henry VIII. The third flag in the British navy is the national or union flag. Originally it bore the cross of St. George combined with that of St. Andrew, but on the legislative union with Scotland in 1707 a new design was adopted, to which the red cross of St. Patrick was added at the union with Ireland in 1800. This device forms the canton or upper corner next the staff in the British naval and commercial flags. The union flag is generally also called the union jack, but according to some authorities the name jack should be restricted to the small union flag displayed from a staff at the end of the bowsprit of war-vessels. The union flag is carried at the main, and is appropriated to the admiral of the fleet of the United Kingdom. On certain occasions it is displayed on shore as well as on sea. The fourth flag is a white flag divided into four quarters by a red cross. This flag is carried at the main by admirals, at the fore by vice-admirals, and at the mizzen masthead by rear-admirals. The ensign in the British navy is a large flag with a white, blue, or red field, bearing the union in the upper inner corner or canton. The white ensign is, in addition, divided into four quarters by the red cross of St. George, and is used exclusively by the royal navy and the royal yacht squadron. The blue ensign is appropriated to the use of the naval reserve and certain yacht clubs, and the red ensign is carried by the merchant marine, by most vessels not connected with the navy, and is commonly used on shore. The flag of the Lord-Lieutenant of Ireland bears the device of the union, with a blue shield in the center charged with a golden harp. It is hoisted at the main of the ship on which the Lord-Lieutenant may embark within Irish waters or on St. George's Channel.

Flags are used as the symbols of rank and command, the officers using them being designated *flag-officers*. Such flags are square, to distinguish them from *broad pennants* and *narrow pennants*.

There are flags also which are symbols of individual authority. Among such are royal standards, flag officers' flags, etc. In the navy of the U. S. the President's flag is rectangular in shape and blue in color, with the arms of the U. S. in the center, surmounted by thirteen stars in the arc of a circle, and is carried in the bows of his barge or hoisted at the main of the vessel on board of which he may be. The flag of the Secretary of the Navy is similar to that of the President in shape and color, but smaller, and has four stars, one in each corner with a vertical foul anchor in the center. The flags of an admiral, vice-admiral, and rear-admiral are rectangular in shape and blue in color, having four stars in the center for an admiral, three for a vice-admiral, and two for a rear-admiral. A commodore's broad pennant was swallow-tail in shape and blue in color, with one star in the center. In the event of two or three flag-officers being present, the senior's flag is blue, that of the second in rank red, and the junior's white.

To strike the flag is to lower the national colors in token of submission.

Flags, signal, are described under NAVAL SIGNALS.

Flag-captain, or *fleet-captain*, the chief of staff of a flag-officer or commander-in-chief; generally the captain of the flag-ship.

Flag-lieutenant, a lieutenant on the staff of a commander-in-chief.

Flag of truce, a white flag displayed to an enemy to indicate a desire to communicate. See INTERNATIONAL LAW.

In monarchical countries the royal standard is worn at ceremonies in honor of the sovereign and at those at which the sovereign may be present.

The white flag is the symbol of peace, and is used as the flag of truce or in token of surrender.

The red flag, bidding defiance, is often used by revolutionists. In the U. S. service, when hoisted at the fore of a vessel, it shows that she is receiving or discharging her powder.

The yellow flag shows a vessel to be in quarantine.

Flags are said to be at half-mast when they are hoisted but half the height at which they are ordinarily worn, and in this position designate mourning.

Dipping the flag is a salute to a fort or passing vessel by lowering it slightly and hoisting it again.

A pennant is a flag much longer in the fly than in the hoist. The *narrow* or *long* pennant, also called *coach-whip* and *streamer*, is carried at the masthead of a government vessel in commission. The *broad* pennant, such as carried by a commander's vessel, is sometimes pointed, and usually has its fly about twice its hoist. See FLAG-OFFICER.

Revised by JAMES MERCUR.

Flag′ellants [from Lat. *flagel'lans*, pres. partic. of *flagella're*, to whip, deriv. of *flagel'lum* (whence Eng. *flail*), dimin. of *flagrum*, a whip, scourge]: a name given to companies of persons in the Middle Ages who marched and sang and scourged themselves in public places for their own and others' sins. Self-flagellation, as a penance, had its origin in the monasteries, and is of early date. It was first recommended to others than monks about the year 900 by Reginō (d. 915), Abbot of Prüm, in Rhenish Prussia, in his *De Disciplina Ecclesiæ*, ii., c. 442, but it did not become a popular penance till after the time of Peter Damiani (1007–72 A. D.), by whom it was earnestly advocated. During the thirteenth, fourteenth, and fifteenth centuries the Flagellants became a sort of intermittent order of fanatics, frequently reappearing here and there in times of extraordinary declension or distress. Three such outbreaks are specially prominent: 1, in Upper Italy, 1260 A. D., in connection with the struggle between the Guelphs and the Ghibellines; 2, in 1349 A. D., while the black plague was raging; 3, in 1414, when many were beginning to be dissatisfied with the papal Church. The Flagellants generally enrolled themselves for the term of thirty-four days—a day for each year in the life of Christ. Stripped to the waist and scourging themselves with knotted whips, they marched with songs and banners from town to town. In market-places they would fling themselves upon the ground, with arms extended in the form of a cross, plying their whips till the blood came. Blood so drawn was thought to have an atoning efficacy. Other wild notions were entertained. The celebrated John Gerson (1363–1429) wrote against them, and they were condemned by the Council of Constance (1414–18). Their last appearance in Germany was in 1481. In spite of all their extravagances, their existence served as a sort of protest against the blind ritualism of the age. See the standard authority on the subject, E. G. Förstemann, *Die christlichen Geisslergesellschaften* (Halle, 1828); cf. W. M. Cooper, *Flagellation and the Flagellants* (London, 1870). Revised by S. M. JACKSON.

Flagella′ta: a group of Protozoa. See INFUSORIA.

Flagel′lum, pl. **Flagella** [from Lat. *flagellum*, a whip]: a name given to the long, whip-like, vibratory organ possessed by many microscopic animals and plants, and serving for purposes of locomotion, etc. A flagellum is simply a single, long cilium. See CILIA. F. A. L.

Flageolet′ [from Fr. *flageolet*, whistle, flute, dimin. of O. Fr. *flageol* < Lat. **flauti'olus*, dimin. of *flauta*, flute]: a musical instrument consisting of a wooden or ivory tube with a mouthpiece at one end, the other end being open. It has one large aperture near the mouthpiece and six or more finger holes. Its invention is ascribed to one Flavigny in 1580, but the flutes of the ancients, like those of some modern barbarous nations, were simply flageolets.

Flaget, flaa'zhā, BENEDICT JOSEPH, D.D.; Roman Catholic bishop; b. in Contournat, Auvergne, France, Nov. 7, 1763; received his first education in France; emigrated to America, and was consecrated Bishop of Bardstown Nov. 4, 1810. The name of the diocese was changed, and he became in 1848 Bishop of Louisville. D. in Nazareth, Ky., Feb. 11, 1850.

Flagg, GEORGE WHITING: See the Appendix.

Flagg, ISAAC, Ph. D: educator; b. in Beverly, Mass., Sept. 7, 1843; A. B., Harvard, 1864; A. M. 1887; Ph. D., Göttingen, 1871; tutor Harvard College 1865–69; Professor of Greek, Cornell University, 1871–88; associate Professor Classical Philology, University of California, 1891–; author of *Demosthenes's Hellenic Orations* (1880); *Versicles* (1883); *Æschylus's Seven against Thebes* (1886); *Euripides's Iphigenia among the Taurians* (1889). C. H. THURBER.

Flagler, ISAAC V.: See the Appendix.

Flag-officer: a generic term signifying a naval officer of rank high enough to command a fleet (see NAVAL TACTICS) or one of the sub-divisions of a fleet, and the naval equivalent of the military term *general officer*. The symbol of his rank is a FLAG (*q. v.*), as distinguished from the *broad pennant* of a commodore, or the *coach-whip* (long pennant) of a captain or commander. There are three grades of flag-officers—viz., *admiral*, ranking with general of land forces; *vice-admiral*, ranking with lieutenant-general; and *rear-admiral*, ranking with major-general. The ship of a flag-officer is called the *flag-ship*—a designation applied to the ship of a commodore when commanding more than one ship.

Flagstaff: See the Appendix.

Flagstone [*flag* < M. Eng. *flagge*, akin to Icel. *flaga*, flake, slab]: stone separable into broad flat slabs suitable for sidewalks, curbing, doorsteps, etc. In Great Britain the word *flag* is used in the same sense. Flagstones are derived from various sandstones and limestones of the sedimentary series and slates and schists of the metamorphic, all of which are sometimes divided by natural partings into layers of convenient thickness. Availability is further determined by breadth between the cross-partings called joints, by durability under wear, and by inability to acquire a high polish. Rocks readily polished are objectionable because slippery when wet. The rocks in greatest demand are sandstones of fine grain in which the cementing material is at the same time strong and less hard than the grains. Slate, although less durable, is much used for interior flooring, and limestone of open or crystalline structure is also employed. As there is no sharp line of separation between flagstones and building-stones, and as they are frequently obtained from the same quarries, the statistics of the flagstone industry have never been separately gathered. A variety of sandstone called *bluestone*, occurring at various horizons in shales of Devonian age and obtained from many localities in New York, New Jersey, and Pennsylvania, is largely used for this purpose.

Flagstones do not belong to any particular geologic age, and they occur at so many localities that the extent to which they are quarried in any region depends largely on the local demand. Prominent among the present sources of supply are the bluestone just mentioned, the Medina sandstone (Silurian) of New York, the Waverly sandstone (Devonian) of Ohio, and the Triassic "brownstone" of Connecticut and New Jersey.

The purpose of flagging is also subserved by various other materials. Various massive rocks, including sandstones, granites, and crystalline marbles, are sawn to the required thickness; and a variety of concretes and artificial stones are likewise employed. G. K. GILBERT.

Flahaut de la Billarderie, flaa'ō'de-laa-bēel'yaard'ree', AUGUSTE CHARLES JOSEPH, Count de: French general and diplomatist; b. in Paris, Apr. 21, 1785; entered the army at the end of 1799, became a colonel in 1809, and was aide-de-camp to Napoleon in 1813. In Oct., 1813, he distinguished himself at Leipzig, and was made a general of division and count of the empire; in June, 1815, fought at Waterloo, and after the battle advocated the succession of Napoleon's son. He left France after the second restoration, but returned in 1827, and in 1830, by the Revolution, was restored to his peerage and rank in the army. He was ambassador to Berlin in 1831, to Vienna in 1841–48; was made senator in 1853; was ambassador to London Dec., 1860. D. in Paris, Sept. 2, 1870.

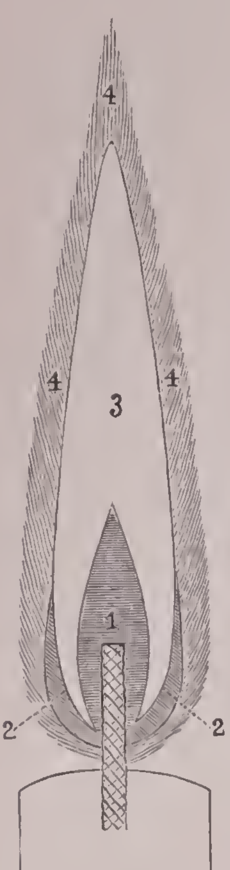
Flamborough Head: a promontory on the Yorkshire coast, England. It is formed by a range of steep, almost perpendicular chalk-cliffs, from 300 to 450 feet high, and bears on its headland a lighthouse whose revolving light (lat. 54° 7′ N., lon. 5′ W.) can be seen at a distance of 30 miles. Across the peninsula runs a ditch with ruins of old fortifications, called "Danes' Dyke."

Flamboyant, flăm-boi'ant [Fr., flaming, pres. partic. of *flamboyer*, to flame < O. Fr. *flambeoir*, deriv. of *flambe*, flame]: in architecture, a term used to designate generally a florid and showy style of design and decoration, and in particular that phase of mediæval French architecture which prevailed during the fifteenth century. During this period the rigid constructive logic of the earlier French Gothic architecture gives way to an unrestrained exuberance of decorative fancy, accompanied by great ingenuity and skill in executing details of extraordinary richness and complexity. Minute open-work tracery, with flowing lines and "fish-bladder" or "palm-leaf" openings, whose flame-like outlines gave rise to the name of the style; arches of various forms inclosed under hood-molds of ogee outline, terminating in rich finials; a general laxity of profiles in the moldings; the frequent suppression of interior pier-caps, and a thoroughly realistic and pictorial treatment of decorative sculpture, are characteristic of this period, which corresponds to the "Perpendicular" in England. Among its masterpieces are the façades in Rouen of the cathedral, the Church of St. Maclou, and the Palais de Justice; of the churches of St. Wulfrand at Abbeville and St. Jacques at Dieppe; the choir of St. Séverin in Paris, and many splendid choir-screens and inclosures at Troyes, Amiens, Chartres, and elsewhere. In Belgium, which was architecturally a province of mediæval France, the cathedral of Antwerp and the town-halls of Louvain and Ypres are a few among many examples of flamboyant design. A corresponding phase of Gothic architecture prevailed in Germany throughout the fifteenth century and well into the sixteenth, with extravagances even less restrained by a refined taste than in France. A. D. F. HAMLIN.

Flame [M. Eng. *flame*, *flaume*, *flaumbe*, from O. Fr. *flambe*, by-form of *flamme* < Lat. *flam'ma*, deriv. of *flagra're*, burn]: a mass of visibly glowing gas; ordinarily, of a gas in process of combustion with air or oxygen. But flame may accompany the combination of any gaseous bodies, provided the action be sufficiently intense to produce luminosity; or it may even result from the intense heating of a gas whose nature is not thereby changed. As a consequence of their high temperature, the gases constituting a flame will have a tendency to rise and form upward currents; this fact, and the circumstance that combustion as well as cooling proceeds from the outside inward, determines the erect and tapering form of undisturbed flames.

Structure of a Regular Hydrocarbon (candle, lamp, or gas) *Flame.*—In a candle-flame four distinct portions are readily distinguished, differing both in their aspect and in the nature of the processes producing them: 1. Immediately surrounding the wick there is a dark space of conical shape (No. 1 of figure) filled with the combustible gases formed by the first action of the heat on the fuel (wax, tallow, etc.), together with those flowing in through the base of the flame. The temperature in this dark space is quite low, and it is void of oxygen, so that neither will gunpowder explode nor phosphorus burn in it. 2. Surrounding the base of the dark cone and the lower portion of the luminous part is a cup-shaped zone (No. 2), of a blue tint, faintly luminous, but sharply defined. It results from the sudden and complete combustion of the gases of the dark cone, with a full supply of air (or oxygen) striking them from without. When the natural draught is artificially increased beyond a certain limit, the edges of the blue cup contract, and finally coalesce above, suppressing the luminous part, and forming a short conical blue flame; or if the blowpipe be used, there results an elongated cone, forming part of the "oxidation flame" of blowpipe practice, but itself possessing a slight reducing action. Its temperature is high. 3. Above the dark cone (1) lies the brightly luminous portion of the flame (No. 3), when it exists at all; its extent depending (other things being equal) upon the relative amount of carbon present in the fuel. In a wax, tallow, or coal-gas flame it forms a slender rounded cone with hollow base; while in that of alcohol it appears as a thin paraboloid (inverted cup-shape) zone. Its prominent characteristic is the separation of highly heated and therefore luminous carbon, out of its combinations with hydrogen, by the intense heat of No. 4, the exterior zone of final and complete combustion.

The latter, a faintly luminous halo (the "outer veil"), surrounds the flame on all sides, and is its hottest portion. The maximum of temperature is a little *above* the point of the luminous cone, where also is found the highest *oxidizing* power; while just *within* the luminous point high temperature and the presence of free carbon co-operate to produce the most energetic *reducing* action.



Flame.

Luminosity of Flames.—The luminosity of flames varies between wide limits, from the faintly luminous and (in daylight) almost invisible flames of hydrogen, carbonic oxide, or sulphur, to the intense brilliancy of the "Bude light," in which coal-gas is burnt with pure oxygen, and of the magnesium flame. Frankland has shown that faintly luminous flames may become intensely so when the gases are strongly compressed during combustion. Under ordinary circumstances, however, useful luminosity is dependent upon the presence in the flame of a sufficient (yet not excessive) amount of a highly heated solid: usually carbon, which in ordinary candle, lamp, or gas flames is liberated from the combustible gases by the influence of the high temperature of the exterior portions of the flame, through which no free oxygen can pass inward. But when illuminating gas is, previous to combustion, mixed with air or oxygen sufficient for the complete combustion of all its ingredients, the separation of carbon, and consequent luminosity, will be suppressed, while the temperature is greatly increased. This is the principle upon which the "Bunsen burner" is based, the body of whose flame represents the blue cup (No. 2) or the "oxidation cone" of the blowpipe. By varying the supply of air the flame may thus, at will, be made to exert an oxidizing or a reducing effect—a principle of most important practical application in the management of the reverberatory and gas furnaces used in metallurgical operations, where the flame, urged either by draught or blast, or by both combined, is readily varied in character to suit the requirements of any stage or kind of process.

The temperature of flames depends primarily upon the nature of the fuel, upon the rapidity and completeness of combustion, and upon the amount of inert gas mixed with the active ingredients. The hottest flame is that of pure hydrogen burning with half its bulk of pure oxygen; but a hydrogen flame burning in air is less hot, because four-fifths of the air is an inert gas (nitrogen), which has also to be heated. Still less hot is the flame of coal-gas in air, because it consists in part of carbon, whose combustion generates less heat than does that of hydrogen.

The measurement of flame temperatures is a matter of very great difficulty. The following are the values for the hottest portions of a few flames which have been subjected to experiment:

Bunsen flame (non-luminous)....	1,360° C.	(Rossetti).
Stearin candle-flame............	940° C.	"
Locatelli lamp-flame............	835° C.	"
Alcohol flame..................	1.180° C.	"
Gas flame (argand burner)......	1,373° C.	(Crova).

According to Rogers (Silliman's *Journal*, 43, p. 301), the flame of the common blast-lamp is about 150° hotter than that of the Bunsen burner, while the flame of burning magnesium occupies an intermediate position, being at least 50° lower than the blast-lamp flame.

The color of flames depends in part upon the substances that are vaporized within them, and is very characteristic, especially when observed with the spectroscope. Thus compounds of sodium (such as common salt) produce a yellow tint; copper, green and blue; calcium (lime), orange-red; strontium, crimson; potassium, violet, etc. Such flames show bright line spectra; the spectrum of ordinary illuminants, however, is simply that of solid incandescent carbon heated to a temperature of rather more than 1,000°. It is a continuous spectrum with the maximum of energy in the infra-red. Of the apparent light-giving area of ordinary gas-flames, only about 1 per cent. is actually occupied by luminous particles. A bat's-wing burner, for instance, of 5 sq. inches apparent area will not exceed in candle-power an incandescent lamp of the same temperature the area of the filament of which is ·05 inches.

Revised by E. L. NICHOLS.

Fla'men [Lat., priest, connected either with Goth. *blōtan*, worship, or with Sanskr. *brahman-*, priest]: a Roman priest devoted to the service of one deity. They were at first three (established by Numa), but were increased ultimately to fifteen, constituting two distinct classes—viz.: (1) the *Flamines majores*, consisting of only three, the *dialis*, *martialis*, and *quirinalis*, consecrated the first to Jupiter, the second to Mars, and the third to the deified Romulus, and selected from the descendants of patricians only; and (2) the twelve *Flamines minores*, who usually were of the plebeian order. The office was for life, but a flamen could forfeit it by neglect of duty, and was liable to removal if an ill-omened event disturbed any of his sacred performances. Their characteristic dress was the *apex*, a cap either conical or close-fitting, having at the top a pointed piece of olive-wood, surrounded at its base by a lock of wool (*filum*, whence, according to Varro and Festus, the word *flamen* was obtained, but by Plutarch derived from *pileum*, hat), the *læna*, or mantle, and the laurel wreath. The most distinguished of the flamens was the *dialis*, who was required to be the son of parents united in marriage by confarreation. The *flamen dialis* immediately after his appointment, though a minor, was relieved from parental control, and became a *sui juris*. He was never required to give oath, had a seat in the Senate *ex officio*, and, like the highest officers of state, had the use of the *sella curulis* (or chair of state) and of the *toga prætexta*, the assistance of a lictor, the right of sanctuary for his house, and the high prerogative of procuring pardon or respite for criminals. On the other hand, the *dialis* suffered numerous restrictions and deprivations; as, e. g., he was not allowed to mount, or even to touch, a horse, wear a ring, or to touch a dead body. He was forbidden to sleep out of his own bed for three consecutive nights, to leave the city even for a single night (a rule modified by Augustus and Tiberius), and was obliged to resign and remain single upon the decease of his wife, who assisted him in the performance of some of his sacred functions. She was called *flaminica*, and was subject to restrictions like those by which her husband was fettered. The *flamen dialis* was chosen by the Pontifex Maximus from three candidates, nominated by the pontifices. See Marquardt, *Römische Staatsverwaltung* (vol. iii., pp. 313–323).

Revised by G. L. HENDRICKSON.

Flameng, flaa'meng, FRANÇOIS: figure-painter; b. in Paris in 1859; pupil of his father, Leopold Flameng, the engraver, and of Cabanel, Hedouin, and Jean Paul Laurens; second-class medal, Salon, 1879; medal of honor, Paris Exposition, 1889; Legion of Honor 1885. An artist of fine ability; among his most important works are *The Girondins Summoned* (1879) and *The Bowlers* (1886). *Grolier and Aldus* is in the Grolier Club, New York. Studio in Paris. W. A. C.

Flamingo, flă-ming'gō [from Portug. *flamingo*: Span. *flamenco*; cf. Prov. *flamant*, flamingo, pres. partic. used as noun of *flamar-*, to flame]: a bird of the genus *Phœnicopterus*; distinguished by a bill bent downward for half its length and provided with tooth-like projections, or lamellæ, similar to those of a duck's bill. The neck and legs are long, the feet webbed. On account of their long legs the flamingoes were formerly classed with the waders, but they seem rather to be aberrant ducks, and are now placed with those birds in the order *Anseres* or *Chenomorphæ*, or occasionally set apart in the order *Odontoglossæ*. Several species are known inhabiting tropical or warm countries, the most familiar being *Phœnicopterus antiquorum* of Southern Europe and Northern Africa, and


Flamingo.

P. ruber of tropical America, the latter still occasionally found in Florida and along the Gulf coast, although it has been practically extirpated in those localities. Flamingoes build a nest of mud in wet localities, or even in the water, and as these nests are built on year after year, they vary in height from 6 to 18 or 20 inches. The statement, based on an old account of Dampier's, that the birds sit or stand astride of the nest is erroneous, for their legs are doubled beneath them in the usual manner of birds. A curious, small flamingo (*Phœnicoparrus andinum*) is found in the Andes. F. A. Lucas.

Flamin'ian Way [translation of Lat. *Via Flaminia*; *via*, way + *Flaminia*, fem. of *Flaminius*, pertaining to Flaminius]: the principal northern road which led from ancient Rome. It was laid out from the Flaminian gate of Rome to Ariminum by C. Flaminius the Elder in 220 B. C., during his censorship, and with its subsequent extensions and branches finally reached nearly all the large towns of Northern Italy. Its remains are still visible at various points.

Flamini'nus, Titus Quintius: a general of the Romans; b. about 230 B. C.; became quæstor in 199 and consul in 198; invaded Epirus, which he subjugated; gained in 197 the great battle of Cynoscephalæ over Philip, the last King of Macedon; proclaimed at the Isthmian games, in 196, the independence of Greece; overthrew the tyrant Nabis in the Peloponnesus in 195; triumphed in 194; was ambassador to Greece in 192–190; censor in 189; envoy to Prusias of Bithynia 183, designing to arrest Hannibal, who was an exile there. D. about 174 B. C.—His brother, Lucius Quintius Flamininus, was an able general and admiral, notorious for vice and cruelty.

Flamin'ius, Caius: a Roman of plebeian birth; became tribune 232 B. C., and carried an agrarian law against the strongest opposition; was prætor in 227; as consul in 223 defeated the Insubrian Gauls and triumphed, but was deprived of his office by the senate; was magister equitum to M. Minucius Rufus 221, but both had to resign immediately, on account of the squeaking of a mouse, an evil omen; was one of the censors in 220, and constructed the Flaminian Way and the Flaminian Circus; again consul in 217; marched against Hannibal, and was defeated and slain in the battle of Lake Thrasymene, June 23, 217 B. C. Flaminius was a man of singularly bold and decided character, hated by the aristocrats and idolized by the common people. —His son, Caius Flaminius, was an able general, consul in 187 B. C.

Flammarion, flaa'maa'ri-ōn', Camille: astronomer; b. at Montigny-le-Roi, Haute-Marne, France, Feb. 25, 1842; studied in the imperial observatory from 1858 to 1862, when he became editor of *Cosmos*. In 1865 he was appointed scientific editor of the *Siècle*; in 1868 made several balloon ascensions to study the atmosphere at great altitudes. He has written a number of books, some of which are of a popular character, including *La Pluralité des Mondes Habités* (1862); *Les Mondes Imaginaires et les Mondes Réels* (1864); *Les Merveilles Célestes* (1865); *Dieu dans la Nature* (1866); *Histoire du Ciel* (1867); *Contemplations Scientifiques* (1868); *Voyages Aériens* (1868); *Astronomie sidérale* (1879); *Astronomie populaire* (1880); *Dans le Ciel et sur la Terre* (1886); *Uranie* (1889).

Flam'steed, John: first English astronomer royal; b. at Denby, Derbyshire, Aug. 19, 1646; graduated at Cambridge University, taking M. A. there in 1664; early began the study of the stars; was ordained a clergyman, and obtained the living of Bristow, Surrey, in 1684. He had been appointed astronomer royal in 1675, and finished the observatory of Greenwich in 1676. Here he passed his life in observation, determining the position of 2,934 stars; erected a mural arc in Sept., 1689; quarreled with Sir Isaac Newton, but ultimately adopted his philosophy. His great work was *Historia Cœlestis Britannicæ*, published in 1725 in 3 vols., the first trustworthy catalogue of the fixed stars. D. at Bristow, Dec. 31, 1719.

Flanders: the territory formerly comprising two provinces of Belgium (East and West Flanders), the southern portion of the province of Zealand, in the Netherlands, and two departments of France (Nord and Ardennes). In the latter part of the ninth century this territory was given by the French King Charles the Bald as a fief to his son-in-law, Baldwin with the Iron Arm, Count of *Vländergau*, who gave the country its name, and who by his prudent management laid the foundation of that agricultural, industrial, and commercial prosperity which soon afterward made it powerful. A spirit of independence and republicanism sprang up with material success, and the relations between the Flemish towns and the Counts of Flanders was often very loose. On the marriage of Marguerite of Flanders to Philip the Bold of Burgundy (1384), Flanders became united to Burgundy, and a century later (1477), on the death of Charles the Bold, it passed, together with that country, to the house of Hapsburg by the marriage of Mary of Burgundy to the Archduke Maximilian. On the abdication of Charles V., in 1556, Flanders and Burgundy came into the possession of the Spanish line of the house of Hapsburg with Philip II., but the territory of Flanders was soon considerably diminished, a northern portion of it being transferred to the States General by the Peace of Westphalia (1648), and a southern portion being conquered by Louis XIV., and secured to him by the Peace of Utrecht (1713). The remainder of Flanders fell again by the Congress of Rastadt (1714) to the Austrian line of the house of Hapsburg, but in 1794 it was conquered by the French and incorporated with the French republic, and afterward with the empire, until the Congress of Vienna (1814) conferred the territory on the kingdom of the Netherlands, to which it remained united until the formation of the kingdom of Belgium in 1831, when most of it was incorporated in that country. But under all these changes Flanders was always rich and prosperous, for it was industrious and enterprising, and it was always independent or fighting for its independence. Flemish influence on commerce and industry, on literature and art, on morals and fashions in Europe, has been very considerable, and to the student who wishes to understand the relation between energy and prosperity, and between prosperity and morals, its history is a rich source of information. See Flemish Language and Literature.

Flanders, East, province of Belgium, bounded N. by Holland; area, 1,158 sq. miles. Pop. (1896) 1,002,300; 865·5 to the sq. mile. It is the most thickly peopled region in Europe. Its surface is a low and level plain belonging to the Scheldt basin. Its soil, though in many places sandy, has been made exceedingly fertile by spade cultivation and an excellent system of manuring. Flax and hemp are its most valuable productions; linen, laces, damasks, and bobbinet its most valuable manufactures. The principal towns are Ghent and Dendermonde.

Flanders, West, province of Belgium, bounded N. by the North Sea and W. and S. by France; area, 1,249 sq. miles. Pop. (1896) 781,261. The surface is flat, for the most part belonging to the Scheldt basin, but with a range of low sandy hills along the coast. Its soil is sandy, but well cultivated and fertilized, though not so productive as that of East Flanders. The principal towns are Bruges and Ostend.

Flandrin, flaañ'drăñ', Jean Hippolyte: historical and portrait painter; b. in Lyons, Mar. 23, 1809. Pupil of the sculptor Legendre, of Revoil at Lyons Academy, and of M. Ingres; Grand Prix de Rome (1832); officer Legion of Honor (1853). He was very poor in the earlier part of his career, but obtained recognition on his return to Paris from Rome in 1838. His portraits are excellent, and his decorative work is notable for its attention to form, and is strong in color quality. He executed frescoes in St.-Germain-de-Prés (1842–61) and St. Vincent de Paul (1850–54), Paris, St. Paul, Nîmes (1847-49), and other churches, and in the Conservatoire des Arts et Métiers, Paris (1854). One of his important pictures, *Dante and Vergil* (1835), is in the Lyons Museum, and a *Study of a Figure* (1855) and *Portrait of a Young Girl* (1863) are in the Louvre. Other portraits are in the Versailles Museum. D. in Rome, Mar. 21, 1864. —His brother Jean Paul (b. in Lyons, May 8, 1811) is a landscape-painter whose works are in the museums of Lyons and Nîmes. William A. Coffin.

Flannel [Fr. *flanelle*: Ital. *flanella*, derived from Celt. *vlan-*, wool, or possibly from Lat. *filum* + *lana* (?)]: a fabric formerly made of wool alone, and still chiefly made of that fiber; but there are silk-mixed, linen-mixed, cotton-mixed, and all-cotton flannels. Flannels with a cotton warp are called dometts. All-cotton goods, baize-woven and having a dense nap on one side, are called canton or cotton flannels. In general flannels have a loose-twisted yarn, and hence their superior warmth. There are many varieties—some twilled and others not—from the translucent gauze undershirting to heavy homespun flannels. Choice flannels are used for men's suits and for ladies' opera-cloaks. Many fancy flannels are now printed in colors. The best flannel is made in the neighborhood of Welshpool and Newtown, in Wales, from the wool of the Welsh mountain-sheep, and is commonly known as Welsh flannel. Large quantities are also made in West Lancashire, West Yorkshire, and the neighborhood of Leeds. Fine light flannel is also made in France and Belgium, approaching in quality to French merinos, though much softer.

Flat: a musical character (♭), the effect of which is the lowering of the note to which it is prefixed a semitone. On the organ and other keyed instruments each black (or short) key is the *flat* of the white key on the right hand, and also the *sharp* of the white key on the left. But as E and F, B and C, are only a semitone apart, and have therefore no intervening black key, F♭ and C♭ are produced by striking the white keys E and B, being the next on the left hand respectively. A double flat (♭♭) lowers a flattened note two semitones. An *accidental* flat is one which affects only a single note or its repetitions in the same bar, except when the first note of the next bar is a mere prolongation of the preceding one. One or more flats placed at the clef, as B, E, A, D, etc., affect all the notes of similar name in every octave throughout a movement, unless contradicted by a natural (♮). Revised by DUDLEY BUCK.

Flatbow Indians: See KITUNAHAN INDIANS.

Flatfish: See DAB, FISHERIES, and PLEURONECTIDÆ.

Flathead Indians: See SALISHAN INDIANS; also SIOUAN INDIANS.

Flathead River: See CLARKE RIVER.

Flattery, Cape: See CAPE FLATTERY.

Flatworms: translation of the scientific name PLATHELMINTHES (*q. v.*), a grand division of the animal kingdom containing the flukeworms, tapeworms, etc. Most of the species of flatworms are parasitic.

Flaubert, flō'bãr', GUSTAVE: author; b. at Rouen, Dec. 12, 1821. He first studied medicine, but afterward devoted himself entirely to literary studies. Originally a pupil of Victor Hugo and Byron, he broke off from the romantic school and became one of the forerunners or first representatives of the realistic or naturalistic school. His first book, *Madame Bovary* (2 vols., 1857), was an unqualified literary success, but met with great opposition on account of its moral bearings. His second book, *Salammbo* (1862), which has Carthage at the time of the Second Punic war for its scene, also made a great sensation, though also encountering considerable opposition from the archæologists. D. in Paris, May 10, 1880. See his *Life* by Tarver (London and New York, 1895).

Fla'vel, JOHN: English Nonconformist clergyman; b. in Bromsgrove, Worcestershire, about 1630; was educated at Oxford, and became rector of Dartmouth in 1656, but was ejected for nonconformity in 1662, and afterward preached in private houses. His works are highly prized, and among them are *Husbandry Spiritualized* (London, 1669); *A Saint Indeed* (1673); *Divine Conduct* (1678); *The Touchstone of Sincerity* (1679); *Personal Reformation* (1691); *Exposition of the Assembly's Catechism* (1693); *The Soul of Man* (1698). His complete *Works* were published in Newcastle (6 vols., 1701; 3d. ed. 1797). D. at Exeter, June, 29, 1691.

Flavia'nus: patriarch of Antioch; b. about 309 A. D. In early life he was a lay monk, zealous for the faith, and according to Theodoret, he, with Diodorus, his associate, first devised the choir and introduced the responsive singing of the Psalter. In 381 A. D. he was chosen Bishop of Antioch to succeed Meletius, but was not fully acknowledged by all factions until 390. In 387 he interceded with Theodosius the Great for the seditious people of Antioch. He strongly opposed Arianism and the Messalians, and died in 404 A. D. Chrysostom was one of his pupils.—Another Flavianus was Bishop of Antioch from 498 until in 512 he was banished to Petra, where he died in July, 518 A. D. He is commemorated as a confessor by the Roman Catholic Church July 4.

Flavianus, SAINT: ecclesiastic; became Bishop of Constantinople 446 A. D., and was from the first opposed by Theodosius II., the emperor, who favored the Eutychian heresy. Flavianus called a synod which deposed and excommunicated Eutyches (448), but in 449 the emperor convened a council at Ephesus (the robber council), presided over by Dioscurus, Bishop of Alexandria, who was the enemy of Flavianus. The latter, who was present, was deposed and ordered to be banished, but was set upon and so beaten by the Egyptian party that he died at Hypepe, Lydia, Aug. 11, 449 A. D.

Fla'vine: a preparation of QUERCITRON BARK (*q. v.*).

Fla'vius: the name of many eminent Romans, mostly of the gens Flavia, an ancient plebeian stock, but many of the Flavii who figure in history were undoubtedly not of this gens, and were indeed not even Romans in a strict sense.—GNÆUS FLAVIUS, a Roman jurist who was curule ædile in 304 B. C., was the son of a freedman and secretary to Appius Claudius Cæcus. His publication of the *Jus Flavianum*, embracing the secret rules of judicial procedure, hitherto known only to pontiffs and patricians, caused great indignation, and made him exceedingly popular with the common people.—Vespasian, Constantine the Great, and many other Roman emperors bore the name of Flavius.

Flax [O. Eng. *fleax*: Mod. Germ. *Flachs*]: a plant important as the source of the fiber from which linen cloth is made, and of flax seed. Like the more important cereal grains, flax was known throughout the ancient seats of civilization in the East. It is therefore impossible to determine where it originated. It is known throughout the civilized world, and is valued as an almost indispensable adjunct of civilization. Its botanical name is *Linum usitatissimum*. The genus *Linum* contains several species, of which this is the only one of especial value or of commercial importance. The *plant* is an annual of quick growth, and probably a race which originated from a species still indigenous to Southern Europe. It grows from 1 to 3 feet high. The leaves are alternate upon the straight slender stem and branches. The flowers, which are in loose terminal panicles, are blue, about an inch in diameter, having a calyx of five sepals, a corolla of five petals, five stamens, and a pistil having five styles. The petals drop within a few hours after the flowers open, and the seed-heads, called *bolls*, form rapidly, becoming finally nearly globular. These consist of ten cells, each containing a flat oval seed of a reddish-brown color, very smooth and glossy. When the plant grows by itself in good soil, it branches freely, blossoms profusely, and yields a proportionately large quantity of seed. When, however, many plants are crowded together, each one grows as a single upright stem, bearing a few blossoms and little fruit at the summit. The valuable portions of the plant are the fibrous coating of the stalk, and the seed. The *stalk* is a woody cylinder, more or less pithy and hollow when dry, and inclosed in a bark consisting of long, strong, silky fibers cemented together by a kind of glue, and encased in an outer bark or skin, which adheres as if glued to the fiber. The *fiber*—when freed from all else, so far as possible, by the processes of rotting, to destroy the glue; breaking, to free it from the woody part of the stalk; scutching, to whip out the small particles of bark and stalk adhering; hatcheling, to straighten it and free it from tangles—is nearly pure bast, of a light grayish-brown color inclining to green, exceedingly tough, adapted to spinning and weaving, capable of being bleached to snowy whiteness and of taking a variety of colors in dyeing, which it holds faster than cotton, though it does not take readily so many dyes.

Flax (*Linum usitatissimum*).

The ultimate filaments are hollow, thick-walled, and thus nearly solid cylindrical cells, which are terminated by exceedingly attenuated points. They are semi-transparent, of a silky luster, and under the microscope the walls of the tube appear like a double line through the center. These filaments vary in thickness from $\frac{1}{650}$th to $\frac{1}{5000}$th of an inch, according to the measurements of Mr. John Phin, who describes the cells as jointed, apparently like the stalks of the bamboo cane. (See FIBER.) When the fiber is separated from the bark and wood of the stalk, as above indicated, it appears in market in two principal forms—namely, "dressed flax" and "tow," which are each of several qualities.

The *seed* consists of the embryo or kernel and its outer coverings, principally its reddish-brown shell, which is very mucilaginous, yielding, particularly to hot water, a thick, glairy gum, becoming quite viscid when cold. The kernel is rich in a valuable oil, which possesses the property of "drying" or hardening on exposure to the air to a remarkable degree (see LINSEED OIL), by which process of drying it gains, instead of losing weight. Powdered flaxseed and powdered oil-cake (linseed meal) are much used in medicine and surgery for poultices, epithems, etc., and are useful on account of their long retention of heat and moisture. The cake remaining after the oil is extracted from the seeds makes when ground an exceedingly palatable and nutritious food for animals, largely used in the U. S. and Great Britain for fattening animals and milch cows.

FLAX-CULTURE.—Flax is a plant of rapid growth, and is sown in April or May and harvested early in August. When raised for seed it makes considerable drafts upon the soil, which should therefore be rich and in fine tilth. As it is almost impossible for manure to be evenly distributed through the soil the first season, it is best to grow flax upon land heavily dunged the previous year as for a corn-crop, but dressed the same season with wood-ashes or some other "hand manure" which can be evenly applied and is adapted to the wants of the land. Good wheat-soils are especially favorable to flax. Heavy clays, coarse gravels, light sands, and peaty soils are not so. Moderately stiff soils should be plowed in autumn, light ones early in the spring. As soon as weeds begin to germinate and grass to grow the land should be thoroughly and evenly plowed and harrowed. If the weather be not favorable to sow, the harrowing may be repeated, and thus successive crops of weeds killed in the seed-leaf. Finally, when the ground is warm in spring the seed should be sown. The practice in Europe is to sow very early; in the U. S. flax should not be sown until after the oat-crop is in—say from Apr. 15 to May 1 in the Middle States. The quantity of seed sown to the acre depends upon the object for which the crop is raised; if principally for seed, half a bushel to three pecks is used; if for fiber mainly, a bushel to a bushel and a half is employed. It is very important that the sowing should be even, for otherwise the tendency to branch is great, and those plants which are less crowded will grow coarser and larger, ripen their seed unevenly, and cause the crop of lint to be of unequal fineness, and to leave much more of the fiber in the tow than otherwise need be. Flax should be sown as carefully as fine grass-seed, and to enable the sower to handle it more easily it is sometimes soaked a short time in cold water and then rolled in plaster. It should be harrowed in evenly with a light harrow, or, better, put in with an improved grain drill. Some farmers, who raise flax for the lint principally, preferring that no horse should tread upon the land after sowing, brush the seed in with a heavy hand bush harrow, made like a stable broom by inserting short pieces of brush in a hard-wood head 5 or 6 feet long. This is drawn over the ground by means of handles attached at right angles, or nearly so, to the brush. It is most important that the flax should get the start of the weeds, and when it is about 3 or 4 inches high it should be carefully examined, and if necessary weeded at once—an operation best done in moist weather and by women and children, who go upon the crop without shoes, and work facing the wind, so that the breeze may favor the downtrodden plants to rise again. It is better to let the weeds grow than to weed the crop after the plants are 6 or 8 inches high, or to do this hurriedly, mashing and bruising the plants. After this the crop is "laid by" until pulling-time.

Pulling.—Flax is ready to pull when it changes color decidedly after blooming, becoming of a yellowish or golden-brown color, two-thirds of the bolls being plump and beginning to turn brown, and the leaves having shriveled and dried upon the lower half of the yellow stalks. Pulling should take place a little earlier than we describe if lint be the principal object, but a little later if the seed pays best. This is done by grasping a handful of stalks in one hand near the tops, and then pulling them with both hands, giving a *steady jerk*, so to speak. This handful is not laid down, but held while other handfuls are pulled, until as much is gathered as can conveniently be grasped: then it is bound after "butting" the roots even. Stalks which fall out and scatter are used for bands. These bundles are set up in long shocks, to become cured thoroughly before stacking. The drying process is greatly shortened if, instead of binding as soon as pulled, the gavels are spread out on the ground, so as to be turned and sunned on both sides before binding.

If the fiber is an important object with the farmer, the flax should be pulled as described, but otherwise it may be mowed with a scythe or cradle, or with a reaper, cutting close as possible to the ground, and harvested and threshed in the same manner as any other grain crop.

Threshing.—After drying and standing in the stacks, or not, as the case may be, the seed may be threshed off by a flail or by beating the heads of the sheaves against a block of wood, which easily removes the bolls. On a large scale the seed is most easily removed by holding the bundles spread out, fan-shaped, upon the cylinder of a threshing-machine, the "concave" being taken off. After this the flax is ready to be subjected to the process called

Retting (*rotting*).—This is conducted either under water, or upon the grass, where the flax is exposed to the action of the dew and sunshine. In "water-rotting" the flax is subjected in the bundles to the action of *soft* water in pools called "dams." The methods of setting or laying the bundles are various, and the rapidity of the action depends upon the warmth and softness of the water, varying from four to fourteen days. It is more uniform if it does not progress very rapidly. During the whole process it must be kept submerged, being weighted with stones. Waters containing iron or other mineral matters are likely to stain the fiber and to hinder the action. It requires some experience to know exactly when to remove the flax, for a few hours may make a considerable difference in the amount of fiber realized. If too much rotted, the lint will break and tangle, and be lost in the tow. If too little rotted, the fiber will break up with the stalk, and be scutched out with the shives. When the rotting (or retting) has been continued long enough, the woody part of the haulm separates easily and completely from the fibrous bark, which itself is easily divided upon the finger into individual fibers. When, however, the process has gone too far, the fiber is weakened, but this can only be quickly detected by the most experienced. When sufficiently rotted, the flax bundles are lifted from the water, opened, and spread upon the grass until perfectly dry. Then they are rebundled and housed until they can be conveniently subjected to the next process, which is

Breaking.—This is accomplished by machines called flax-breaks, which are variously constructed, but all accomplish the same end—namely, the breaking up of the stalks without doing violence to the fiber. A flax-break in common use and easily constructed consists of several hickory slats hinged at one end upon a form, and fastened at the other end into a heavy wooden head. These slats when let down occupy a horizontal position, and shut in between other similar fixed slats, but do not touch them. By means of a handle attached to the head the movable slats are raised up and down by one hand, while the flax held in the other is thrust in and drawn through, and thus "broken," so that the "shives," or pieces of broken stalk, or "boon," may be whipped or "scutched" out.

Scutching or *swingeing* is the next operation, and one performed both by simple hand-appliances and by more complicated machinery. The essential implements are the scutching-block and the scutching-knife. The former is an upright hard-wood board set in a block or fixed in any convenient place. It has in it a large notch, with one edge horizontal and cut to a sharp edge, the bevel being altogether upon one side. This notch is to receive a handful of flax, which, resting upon the sharp wooden edge, hangs over upon one side. The scutching-knife is made of hard wood also, and must be 9 or 10 inches broad and very thin. With this the "hand" of flax is struck sharp blows as it is turned in the notch, the knife being brought down close, parallel with the side of the board. Thus the fiber is freed from most of its adhering impurities, and in this condition is usually baled and marketed in the U. S., but before it can be spun much more is necessary. In this condition the lint and the tow remain together, only the coarsest tow being separated from the fiber by the scutching process.

Hatcheling or *heckeling* consists in drawing the hands of flax-fiber through combs of long iron teeth set filling a circle or a square. The instrument is called a "hatchel" or "heckel," and there are usually two hatchels used—one coarse, for a preliminary operation, the other fine, for finishing. The hand of flax is hatcheled from the tips to the middle—first one half, and then the other, the tow being left in the teeth of the hatchel, and the teeth being frequently cleaned of the same. The ends accomplished by this process are three—namely, the subdividing of the fibers into their finest filaments, the separation and removal of all broken or short fibers (the tow), and the laying of the lint parallel and untangled. The operation requires considerable skill, and upon it depends to a great extent the value of the result. It will be long before American farmers to any great extent will prepare their flax-fiber for market by the careful dressing practiced in Germany, Holland, and Great Britain, but until this is done the value of the crop will be greatly less than it might otherwise be. In general, this crop is and will be cultivated in the U. S. almost solely for the seed, the lint being roughly treated and sold for cordage and for coarse fabrics. The product of flax-seed in the U. S. in 1899 was 29,601,000 bush.: the exports, 2,830,991 bush. The world's product was 68,553,000 bush. Minnesota, Iowa, South Dakota, Nebraska, Kansas, and Missouri were the largest producers in the order named. No statistics were collected for the production of fiber in the U. S. During the "cotton-famine" caused by the civil war greatly increased interest was manifested in flax-culture, and great efforts were made to treat the fiber so that it could be worked upon cotton machinery; but these experiments resulted in no marked success, and were given up when cotton again became abundant. Russia is the largest flax-producing country in Europe, her yield being about two-thirds of the whole production. The total quantity of flax fiber produced in the whole of Europe in 1899 was 1,123,943,000 lb., distributed as follows: Russia, 876,788,000 lb.; Austria-Hungary, 112,809,000 lb.; Italy, 41,917,000 lb.; Belgium, 32,309,000 lb.; France, 27,834,000 lb.; Ireland, 16,034,000 lb.; all other countries, 16,252,000 lb. The total area in Europe sown with flax aggregates about 5,700,000 acres, of which more than 3,700,000 are in Russia. See FLAX, NEW ZEALAND.

Revised by L. H. BAILEY.

Flax, False: See GOLD OF PLEASURE.

Flax Family: the *Linaceæ*, a family of mostly herbaceous flowering plants, with regular flowers, and superior compound ovaries. There are about 135 species widely distributed in temperate and tropical climates. The most important species is the flax (*Linum usitatissimum*) cultivated from time immemorial for its bast fibers. In North America there are twenty-two native species of flax (*Linum*).

CHARLES E. BESSEY.

Flax, New Zealand: a large perennial, liliaceous plant (*Phormium tenax*), native of New Zealand, and grown for its fiber, which is exported to some extent, and used as a substitute for hemp, which is inferior to New Zealand flax in strength, but superior in durability. The fiber is obtained from the long and flag-like leaves, which are 2 to 6 feet long and 1 to 3 inches broad. In the U. S. the plant is cultivated for ornament. See FIBER.

Flaxman, JOHN: sculptor; b. in York, England, July 6, 1755; the second son of John Flaxman. When he was only six months old his father, who had gone to York from London, where he had failed to find sufficient work in his trade of modeler in plaster, returned to the capital, taking his family with him. The elder Flaxman was a good workman; his plaster casts were in great favor with artists, and, although not an artist himself, he had sense and perception enough to encourage the early indications of talent in his afterward famous son. Among the early works of the younger Flaxman were his own portrait-bust, quarter size, modeled in his twenty-third year, two statues, *Grecian Comedy* and a *Vestal*, and many portrait-busts of his friends. During his youth he derived a large part of his support from making models for the use of Wedgwood, the famous maker of fine pottery. In 1787 Flaxman went to Italy, and remained there seven years, living the greater part of that time in Rome. While in Italy he made for Mrs. Hare Nayler the well-known series of designs in outline for the *Iliad* and *Odyssey*; for the Countess Spencer the illustrations to *Æschylus*; and for Mr. Thomas Hope the illustrations for the *Divina Commedia* of Dante. While in Rome he executed several works in marble, but none of them of much importance, if we except the *Cephalus* and *Aurora*, a commission from Mr. Thomas Hope. Shortly after his return to England he made his statue of Lord Mansfield. In 1797 he was elected an associate of the Royal Academy, and in the same year he sent to the exhibition three sketches in bas-relief from the New Testament and the statue for the monument of Sir William Jones. In 1800, being then in his forty-fifth year, Flaxman was elected a member of the Royal Academy, and on this occasion he presented to the Academy a marble group, *Apollo and Marpessa*, in compliance with the rules of the institution, which require from each new member a specimen of his skill. He now produced in rapid succession many of his best works—the monument in memory of the Baring family; the Lushington monument; the monument to the Countess Spencer; to Mrs. Tighe, the poetess; with others to the memory of the Tarborough family, to Mr. Edward Balme, and to the Rev. Mr. Clewe.

Among other statues made by Flaxman were those of Sir Joshua Reynolds, of Sir John Moore, of Pitt, of Joseph Warton, of George Stevens, of the Rajah of Tanjore, of the missionary Schwarz, of Lord Cornwallis, and of Warren Hastings. In his sixty-third year he modeled the group of the *Archangel Michael Vanquishing Satan*. In 1810 the Royal Academy created a professorship of Sculpture, and requested Flaxman to fill the chair. He gave in all ten lectures, and these are the subjects: 1, English sculpture; 2, Egyptian sculpture; 3, Grecian sculpture; 4, Science; 5, Beauty; 6, Composition; 7, Style; 8, Drapery; 9, Ancient art; 10, Modern art. They were published in 1829 in one volume, with 52 plates. D. Dec. 7, 1826. See his *Life* by Allan Cunningham in *British Painters, Sculptors, and Architects.*

Flea [O. Eng. *flēah*: Mod. Germ. *Floh*]: the common name of the insects of the family *Pulicidæ*, wingless creatures constituting an order, *Aphaniptera*, but by some considered as degraded forms referable to the *Diptera*, or two-winged insects. (See ENTOMOLOGY.) They grievously infest the higher animals, the common flea (*Pulex irritans*) attacking man as well as beast, while other species attach themselves to the dog, cat, mole, and various other mammals. The *Sarcopsylla penetrans*, or chigoe, is another flea which seriously troubles man. Most of the fleas are distinguished by great powers of leaping. Accounts are given of fleas trained to perform curious feats which have been often exhibited in public. It is doubtful whether there is any training in the case. The feats which seemingly evince intelligence are rather acts necessitated by the mechanical conditions to which the insect is subjected.


Flea.

Fleabane [*flea* + *bane* < M. Eng. *bane*, destruction < O. Eng. *bana*, murderer]: a name given to various herbs of the family *Compositæ*, especially to those of the genus *Erigeron*. The *Erigeron canadense* and *E. philadelphicum* yield strong-smelling, volatile oils which are sometimes used in medicine as diuretics. The allied genera, *Pulicaria* and *Conyza*, are called fleabanes in England. The destructive powers of various composite plants upon insects appear to reach their maximum in *Pyrethrum carneum* and *roseum* of Asia and Europe, the leaves of which are largely used as an ingredient of the Persian insect-powder, so deadly to insect vermin. The plant has also been used to cure dysentery, and for other medicinal purposes. See OIL OF ERIGERON.

Fleawort Seed (in Lat. *Semen psyllii*): the seeds of *Plantago psyllium*, a kind of plantain of Europe and Barbary. The seeds are mucilaginous, like flaxseed, and are sometimes used for the same purposes in medicine.

Fléchier, flā'shi-ā', ESPRIT: ecclesiastic; b. at Pernes, France, June 10, 1632; was educated by the Fathers of Christian Doctrine at Avignon; taught rhetoric at Narbonne; went to Paris in 1659, where his talents as a preacher won him great preferments. In 1673 he was admitted to the Academy; in 1685 became Bishop of Lavour, and in 1687 was translated to Nîmes, where he was beloved alike by his own Church and by the Huguenots. D. at Montpellier, Feb. 16, 1710. He wrote *Oraisons Funèbres*, *Panégyriques des Saints*, and *Lives* of Theodosius the Great and of Ximenes, etc. See his *Life* by A. Delacroix (Paris, 1865; 3d ed. 1883).

Fleck'eisen, ALFRED: Latin scholar; b. Sept. 23, 1820, in Wolfenbüttel, Germany; studied in Göttingen. After teaching in various cities, he was appointed director of a gymnasium in Dresden in 1861. He is best known by his critical editions of *Plautus* (ten plays), *Terence*, and *Cato*. Since 1855 he has been the editor of the *Jahrbücher für Philologie und Pädagogik*. ALFRED GUDEMAN.

Fleet-captain: See FLAG.

Fleet Marriage: a marriage performed at the Fleet prison in London, which, like Gretna Green in later times, and May Fair and the Savoy at a somewhat earlier date, was long a famous resort for clandestine marriages. Fleet marriages are first mentioned in 1613, and in 1754 were forbidden by statute. The officiators were Church of England clergymen in prison for debt. The most famous Fleet marriage was that of Henry Fox, afterward Lord Holland, to Georgina Caroline Lennox, daughter of the Duke of Richmond. See J. S. Burn, *History of the Fleet Marriages* (1834).

Fleet Prison, or **The Fleet**: a debtors' prison in London. Before 1200 it was in use both as a debtors' and king's bench prison, and remained such until 1641, when, on the abolition of the Star Chamber, it became, like the Marshalsea, a debtors' prison. It was burned in 1381 by Wat Tyler, in 1666 at the great fire of London, and in 1780 by the Gordon rioters. In 1842 it was abolished by statute, and in 1845 pulled down. It was the scene of many disgraceful abuses.

Flegel, flā'gel, EDUARD ROBERT: African explorer; b. in Wilna, Russia, in 1855. His explorations were confined to the Niger-Benue basin. In 1875 he settled as a trader at Lagos. His journey on the steamer Henry Venn, the first steam-vessel to ascend the great Benue tributary of the Niger, resulted in an admirable report on that region in all its aspects. In 1880 the German-African Association supplied the funds needed for an expedition which was to complete the knowledge of the basins of the Benue and Lake Chad. Traveling from the middle Niger to Sokoto by land, he followed an unexplored route to Adamawa, and in Aug., 1882, discovered the source of the Benue. In 1885 he led another expedition up the Benue, under the same auspices, to carry on scientific research and study commercial possibilities, and he died while engaged in this work in 1886. Flegel's work had the effect of stimulating German colonial enterprise, and of directing attention to the Benue, the only African river which affords steam-navigation from the sea to the central portions of the continent. C. C. ADAMS.

Fleischer, HEINRICH LEBERECHT: Orientalist; b. at Schandau, Saxony, Feb. 21, 1801; studied theology and Oriental languages at the University of Leipzig 1818–24, and then went to Paris, where he applied himself to the study of Persian and Arabic. Returning to Germany in 1828 he was made a professor at the Kreuzschule in Dresden in 1831, and in 1836 filled the chair of Oriental Languages at the University of Leipzig, where he died Feb. 10, 1888. He edited Abulfeda's *Historia Moslemica* (1831–34); *Ali's Hundred Sayings* (1837); Baidhavi's commentary on the Koran (1846–48); and among other works wrote a *Critical Dissertation on Habicht's Glossary to the First Four Volumes of the Thousand and One Nights* (1836); an account of the Arabic, Turkish, and Persian manuscripts in the town library of Leipzig, printed in Naumann's *Catalogue* (1838); *Grammar of the Modern Persian Languages* (1875); and *Kleinere Schriften* (1885–88).

Fleming, JOHN: Scotch clergyman and naturalist; b. near Bathgate, Linlithgowshire, 1785; preached in Shetland and at Flisk, Fifeshire; appointed to the chair of Natural Philosophy at King's College, Aberdeen, 1832; resigned the position in 1843, and became Professor of Natural Science in the Free Church College of Edinburgh 1845. D. Nov. 18, 1857. The *Philosophy of Zoölogy* was published about 1822; *History of British Animals*, in 1842.

Fleming, JOHN AMBROSE: See the Appendix.

Fleming, SANDFORD, C. M. G., LL. D: Canadian surveyor; b. at Kirkcaldy, Scotland, Jan. 7, 1827, and educated there. He removed to Canada in 1845; in 1852 was appointed on engineering staff of Northern Railway, and subsequently commissioned to visit Red River to ascertain the advisability of connecting it by railway with Canada. In 1863 he proceeded to Great Britain to present memorial of the inhabitants of the valley of the Red River, petitioning for railway communication with Canada, but was unsuccessful in his mission. Upon his return he was commissioned by Canadian Government to make preliminary survey of projected line of railway to connect maritime provinces with Canada, which work he successfully accomplished. In 1871 he was ordered by the Dominion Government to survey a line that would connect Eastern Canada with the Pacific Ocean, and had successfully prosecuted part of the work when political exigencies led to his resignation. He was created a companion of the order of St. Michael and St. George in 1877; elected chancellor of Queen's University in 1880, an office he now (1901) retains; in 1881 he represented the Canadian Institute and the American Meteorological Society at the International Geographical Congress at Vienna; and in 1884 represented Canada at the International Prime-meridian Congress at Washington, D. C. In addition to engineering reports, etc., he wrote *England and Canada* (1884); *Time and its Notation*; and *The New Time Reckoning*. NEIL MACDONALD.

Flemingsburg: town; capital of Fleming co., Ky. (for location of county, see map of Kentucky, ref. 2–I); on railway; 17 miles S. of Maysville. It has churches of six denominations, a very large graded high school, Masonic and Odd Fellows' hall, two large flouring-mills, and an extensive tobacco-factory; chief products, wheat, corn, and tobacco. Pop. (1880) 811; (1890) 1,172; (1900) 1,268.

EDITOR OF "TIMES-DEMOCRAT."

Flemington: borough and railway junction; capital of Hunterdon co., N. J. (for location, see map of New Jersey, ref. 3–C); 50 miles W. by S. of New York. It is in a rich agricultural district, and has an extensive trade. Pop. (1880) 1,751; (1890) 1,977; not returned separately in 1900.

Flemish Language and Literature: The literal meaning of Flemish (or Vlæmish) is "dialect of Flanders." But the term is generally (although not always) used in a wider sense, in being applied to the language of the Low German inhabitants of Belgium, or, in other words, to "Belgian Dutch," as distinguished on the one hand from "Belgian French" (the so-called "Walloon") and on the other hand from "Hollandish Dutch."

Early Flemish.—It has been mentioned in the article on DUTCH LANGUAGE (*q. v.*) that it is the Flemish dialect that the Middle Dutch literature was based upon. "Flemish literature" and "Dutch (or Dietsch) literature," as far as the Middle Ages are concerned, are synonymous terms, the province of Flanders then being the recognized center of literary culture in the Netherlands. As the Southern Dutch language was adopted for literary purposes by the authors of the northern provinces, Flemish may be said to be the basis not only of Middle Dutch, but to some extent also of Modern Dutch (i. e. the modern literary language, not, of course, the modern Dutch dialects). Still it is from the time of the general adoption of Southern Dutch or "literary Flemish" by the Netherlandish authors that the Dutch literature ceased to be Flemish. After the conquest of Antwerp in 1585, and the political separation of the southern from the northern provinces, the former (viz., East and West Flanders, Antwerp, South Brabant, and Limburg) lost the leading position in Dutch literature, the development of the literary language being from this time more closely connected with that of the Northern Dutch dialects. Literary Flemish, as distinguished from its legitimate successor, the literary Dutch, was not at once abandoned in the southern provinces, but it was then confined to a rather small and unimportant area, and in being later on in official and literary use superseded by French, Flemish was once more reduced to what it had been before, viz., a Low Frankish dialect.

Modern Flemish.—It was not until the early decades of this century that in Belgium a literature which goes under the name of "Flemish" again arose. After the reunion in 1815 of the southern and northern provinces under the name "United Kingdom of the Netherlands," King William I. endeavored to introduce the Dutch literary language into Belgium. He was not, however, successful in his efforts. The people looked upon Dutch as a foreign language, different from their own dialect, and among the cultivated classes the position held by French was too strong to easily submit to another language. When after the revolution of 1830 Belgium and Holland were again separated, and French was made the only official language of Belgium, the fate of the Low German element in Belgium seemed to be decided. But it is just at this time that a new and successful attempt was made at regaining for the Low Frankish part of Belgium a literary language, and at securing for it a position similar to that which Flemish had formerly held. Under the leadership of Frans Willems the so-called "Flemish movement" started, whose followers advocated the adoption by the Belgian authors and the

Belgian Government of Dutch as a literary and as an official language. In their opinion—and this opinion was on the whole correct—the literary Dutch was a modified and more recent form of the language, in which the early Flemish literature was written, so that by adopting Dutch they could hope to regain their connection with the earlier Flemish authors, and to prove themselves the legitimate and worthy heirs of this old and important literature. While in the time of William I. the attempts to introduce Dutch into Belgium had seemed to be made for political purposes, in order to bring Belgium under the influence of Holland, under the "Flemish movement" the same attempts gained a patriotic and a specific Belgian character, and soon became popular. J. F. Willems, who was keeper of the archives of Ghent, published in his quarterly review, *Belgisch Museum* (1837–46), and in separate editions several of the earlier Flemish literary works. In his efforts to awaken the interest of the Belgian people in the adoption and the literary use of the Dutch language, he was supported by several Belgian authors, poets like Ledeganck, Van Rijswijk, Van Duyse, and novelists like Hendrik Conscience writing their works in Dutch. Willems died in the year 1846. In 1851 the Willemsfonds was erected in his honor, whose members, under the guidance of J. F. J. Heremans (d. 1884), and at present of Julius Vuylsteke, have been carrying on the work begun by Willems. A few statements will illustrate the steadily growing success of the "Flemish movement" and the close union which, as one of its consequences, has taken place between the Flemish and Dutch writers and scholars. A *Taal- en Letterkundige Congress* was established in Ghent in 1849, in the interest of the literary language. The congress has since assembled yearly, or at least every second or third year, in one of the chief towns of Belgium or Holland. It is this association which suggested the spelling reform of 1863, and the comprehensive Netherlandish dictionary by De Vries and Te Winkel. In three official regulations by the Belgian Government in 1873, 1878, and 1883, the Dutch language has been acknowledged in Belgium alongside of French as an official language, and the Belgian officials are now obliged to make themselves acquainted with it. The foundation in 1886 of the Koninklijke Vlaamsche Academie was another important step in the same direction. Numerous daily papers and weekly and monthly periodicals are published in Belgian Dutch, the best known of which is the *Nederduitsch Tijdschrift*, commenced by E. Hiel in 1862.

It is important to bear in mind that the modern literary language of Belgium, whose introduction is connected with the Flemish movement, was not based upon the present Flemish dialect, but is identical with the Dutch literary language. However, as the latter originated in the earlier Flemish dialect, there is still a strong connection between Belgian Dutch and the Flemish dialect, although since then more than five centuries have passed; and it seems only natural that the present Belgian dialects should exert some influence on the literary language, the more so as the latter is at the same time (as in Holland) the conversational language of the educated classes. There are other circumstances that tend to differentiate Hollandish and Belgian Dutch to a certain extent—e. g. Belgian Dutch is more likely to be influenced by French and to admit French idioms than its northern sister-language. The Belgian Dutch indeed, for these and similar reasons, differs somewhat from the literary language of Holland, and it is stated by Dutch scholars that even the best Belgian authors, who are most anxious to avoid any traces of dialect, can not write a single page without being recognized by the northern Dutchmen as southerners. However, most of the Belgian peculiarities are confined to the vocabulary, and interfere little with the Dutch character of the Belgian literary language. There is no difference in spelling between Belgian and Hollandish Dutch, as the proposals made in 1863 for a spelling reform have since been generally accepted in both countries.

REFERENCES.—Most of the literature on Flemish is found in the article on the Dutch language. In addition to these the following works may be mentioned: L. W. Schuermans, *Algemeen Vlaamsch Idioticon* (Louvain, 1856–70); L. L. de Bo, *West Vlaamsch Idioticon* (Bruges, 1870–73; 2d ed. Ghent, 1892); K. Brämer, *Nationalität und Sprache im Kgr. Belgien* (Stuttgart, 1887); O. Delepierre, *Sketch of the History of Flemish Literature* (London, 1860); J. v. Düringsfeld, *Das geistige Leben der Vlamingen* (3 vols., Leipzig, 1861.)

HERMANN COLLITZ.

Flemming, WALTHER, M. D.: anatomist; b. Apr. 21, 1843, at Sachsenberg, Germany; educated at Universities of Göttingen, Tübingen, Berlin, Rostock; assistant in physiological laboratory, Amsterdam, 1869–70; tutor in anatomy, Rostock, 1871–72, in Prague 1872–76; Professor of Human Anatomy and Histology, University of Kiel, since 1876. Author of *Studien in der Entwicklungsgeschichte der Najaden* (Vienna, 1875); *Zellsubstanz, Kern und Zelltheilung* (Leipzig, 1882); *Beiträge zur Kenntniss der Zellen u. ihrer Lebenserscheinungen* (*Archiv f. Anat.*, 1879–81); *Neue Beiträge u. s. w.* (in same, 1887–91); *Studien über Regeneration der Gewebe* (Bonn, 1884–85). C. H. THURBER.

Flensborg, flens'bōrch: handsome and thriving town of Schleswig, Prussia,; at the west end of Flensborg Fjord (see map of German Empire, ref. 1–E). It has good ship-yards, excellent oyster-beds, some tobacco manufacture and spinning, and sugar-refining industry. One of the most interesting features of the town is the great tomb in which the Danes buried their dead after the battle of Idsted, July 25, 1850. Pop. (1890) 36,894.

Flesh [M. Eng. *flesch, flesc* < O. Eng. *flǣsc* : O. H. Germ. *fleisc* > Mod. Germ. *Fleisch*, meat, flesh]: ordinarily, all solid animal tissues, excluding the bones; in a narrow sense, the muscular tissue of animals, especially of the vertebrates. In a still narrower popular sense the muscular tissues of fishes, reptiles, and birds are excluded. In the broadest sense the flesh of animals comprises not only muscles, but fasciæ, fibrous, adipose, and other tissues, cartilage, nerve-substance, the parenchyma of the viscera, etc.; each of which is described under its alphabetical head.

Fleshfly, or **Blowfly**: any one of the various insects of the order Diptera, family *Muscidæ*, of which the best known is the *Sarcophaga carnaria*, the common fleshfly. The *Musca* (or *Lucilia*) *cæsa*, *Musca* (or *Calliphora*) *vomitoria*, and other species are common to both continents, and deposit their already hatched larvæ upon fresh meat and decaying animal matter—sometimes on the wounds of soldiers—giving rise to a crop of maggots.

Fletcher, ANDREW, OF SALTOUN: publicist; b. at Saltoun, Scotland, in 1653; had for his first teacher the celebrated Gilbert Burnet, who at that time was minister of the parish, and finished his education on the Continent, where he spent several years in travel and studies. As a member of the Scottish Parliament in 1681 he opposed the royal court, and was forced to retire to Holland. Returned to England in 1683; took part with the Duke of Monmouth in 1685; served in Hungary against the Turks in 1686; returned to England with William of Orange in 1688; brought forward the bill of security in the Scotch Parliament in May, 1703; and opposed the terms of the union in 1706, proposing a measure of limitations which would have failed to effect a complete and permanent union of the two kingdoms. D. in London in 1716. His *Political Works* were published in 1737.

Fletcher, JOHN: dramatist; b. in Northamptonshire, England, in 1579. He was the son of the Bishop of London, was educated at Corpus Christi College, Cambridge, and devoted his life to writing for the stage. He produced alone, or in conjunction with Francis Beaumont, fifty-two dramas, among the best of which are *The Maid's Tragedy*, *Philaster*, *The Faithful Shepherdess*, *The Knight of the Burning Pestle*, *The Scornful Lady*, *Rule a Wife and Have a Wife*, and *The Spanish Curate*. "Such a total of work," says Saintsbury in his *Elizabethan Literature*, "so varied in character and so full of excellences in all its variety, has not been set to the credit of any name or names in English literature if we except only Shakspeare." Fletcher died in London in 1625 of the plague. H. A. BEERS.

Fletcher, JOHN WILLIAM, originally **de la Flechère**: theologian; b. at Nyon, Switzerland, Sept. 12, 1729; studied at Geneva; served in the Portuguese and Dutch armies; visited England, and became a minister of the Established Church in 1757, becoming vicar of Madeley 1760. He wrote in defense of Wesley's Arminianism. The Countess of Huntingdon appointed him president of her theological school at Trevecca, Wales, 1768. His principal work was *Checks to Antinomianism* (1771). He was one of the founders of Methodism, and a man of great industry and piety and of most amiable and saintly character. He was also a keen polemic. D. at Madeley, Aug. 14, 1785. His complete works have been published (London, 1800–04; 8th ed. 1826, 7 vols.). See his *Life* by Luke Tyerman (London, 1882) and by F. W. Macdonald (1885).

Fletcher, PHINEAS: poet; b. in England in 1582; entered Cambridge University in 1600, and became rector of Hilgay, Norfolk, in 1621. He wrote various poems—*The Locustæ, or Apollyonists*, a satire against the Jesuits (1627), rare; *Sicelides, a Dramatic Piece* (1631); *Joy in Tribulation* (1632); *The Purple Island, or The Isle of Man*, together with *Piscatoric Eclogues and other Poetical Miscellanies* (1633), etc. D. at Hilgay in 1650. He was a cousin of Fletcher, the dramatist, and a brother of Giles Fletcher (1588–1623), a clergyman, and author of the fine poem *Christ's Victory and Triumph* (1610).

Fletcher, ROBERT, M. D.: anthropologist; b. at Bristol, England, Mar. 6, 1823; educated at private schools, at the Bristol Medical School, and the London Hospital; member of the Royal College of Surgeons of England; M. D., Columbian University, Washington, D. C.; surgeon of First Ohio Volunteer Infantry 1861, and later surgeon of volunteers; assistant to Dr. J. S. Billings in the preparation of the *Index Catalogue* of the library of the surgeon-general's office, U. S. army; co-editor with Dr. Billings of the *Index Medicus*; vice-president of the Philosophical Society of Washington; for four years president of the Anthropological Society at Washington; was Professor of Medical Jurisprudence in Columbian University; author of *Paul Broca and the French School of Anthropology* (1882); *On Prehistoric Trephining and Cranial Amulets* (1882); *Human Proportion in Art and Anthropometry* (1883); *A Study of Some Recent Experiments in Serpent Venom* (1883); *Tattooing among Civilized People* (1883); *The New School of Criminal Anthropology* (1891), and other works.

Fleur de Lis, flēr'de-lēēs', often Anglicized into **Flower de Luce** [Fr., lily-flower; *fleur*, flower + *de*, of + *lis*, lily]: the flower of the *Iris sambucina* (family *Iridaceæ*), a plant native in the South of Europe and cultivated for many centuries in gardens. This flower is famous as the emblem of the French kings, whose arms in later times were azure, three fleurs de lis, or, borne two and one. Many curious legends were related as to the origin of this emblem. The historical fact appears to be that the Frankish kings employed the fleur de lis as a kind of badge long before the proper rise of heraldry.

Fleurus, flö'rüs': town of Hainaut, Belgium; 7 miles N. of Charleroi (see map of Holland and Belgium, ref. 11–E). Here Gonsalvo of Cordova was defeated by the Duke of Brunswick and Count Mansfeld Aug. 29, 1622; Waldeck was defeated by Marshal Luxembourg July 1, 1690, and the Prince of Coburg, having gained here a virtual victory over Jourdan, June 26, 1794, lost its fruits, and indeed the whole of Belgium, by bad strategy after the fight. The battle of Ligny, 1815, took place a mile or two north of Fleurus. Pop. (1891) 5,148.

Fleury, flö'ree', ANDRÉ HERCULE, de: cardinal; b. at Lodève, France, June 22, 1653; studied at the Jesuit College, Paris; was made Bishop of Fréjus 1698; in 1715 became preceptor to Louis XV.; in 1721 was admitted to the Academy; in 1726 assumed the position of Prime Minister of France, and was made a cardinal. His policy was to foster the sciences and arts, to increase the internal prosperity of France, and to reduce the expenses of the Government; hence he favored peace, but he lacked the vigor to carry out this policy and was dragged into two wars, whose unsuccessful issue was due in no small measure to his mismanagement and parsimony. D. in Paris, Jan. 29, 1743.

Fleury, CLAUDE: abbé; ecclesiastic and historian; b. in Paris, France, Dec. 6, 1640; was advocate to the Parliament of Paris 1658–67, and tutor to the Princes Conti in 1672; in 1689–1707 sub-preceptor with Fénelon to the Dukes of Burgundy, Anjou, and Berri; became member of the French Academy 1696. He was prior of Argenteuil in 1707 and confessor to Louis XV. 1716–22. Published *Morality of Christians, Ecclesiastical Law, Historical Catechism* (1683), etc., but his greatest work is his *Ecclesiastical History* (20 vols., 1691–1720). D. in Paris, July 14, 1723.

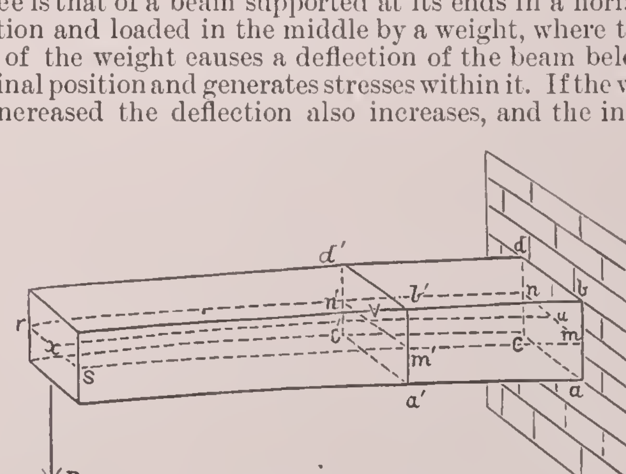
Fleury, ÉMILE FÉLIX: general; b. in Paris, France, Dec. 23, 1815; entered the army in 1837; served eleven campaigns in Algeria; was sub-lieutenant in 1840, captain in 1844, major in July, 1848, and on his return to France a general of brigade Mar. 18, 1856, and general of division Aug. 13, 1863. He was a thorough Bonapartist, and became officer of the Legion of Honor in 1849, and grand officer Aug. 13, 1859. Was summoned to the French senate by decree Mar. 15, 1865; was chief equerry to Napoleon III. Dec., 1865. In 1866 was sent on a diplomatic mission to King Victor Emmanuel and in Sept., 1869, became ambassador at St. Petersburg. In Sept., 1870, he resigned this position, and retired to Switzerland. He was placed on the retired list of the army in Oct., 1879. D. in Paris, Dec. 11, 1884.

Fleury, LOUIS, Chevalier and Viscount de: soldier; b. in Limoges, France, about 1740; joined the Revolutionary army of the British colonists of North America, having received a captain's commission from Washington; served at Fort Mifflin on the Delaware and at the battle of Brandywine, and was promoted to be lieutenant-colonel Nov. 26, 1777. In the winter of 1777–78 he was sub-inspector under Steuben; June 4, 1778, adjutant-general of Lee's division; in July, 1778, was second in command of a battalion of light infantry in the Rhode Island expedition, and then commanded a battalion of light infantry under Washington. He received the thanks of Congress and a silver medal for gallantry in the storming of Stony Point, July, 1779. He returned to France 1780 with Rochambeau, and became one of his officers. He was executed in Paris in 1794.

Flexibility [viâ Fr. from Lat. *flexibil'itas*, deriv. of *flexi'bilis*, flexible, deriv. of *flec'tere, flex'um*, bend]: that quality by which certain bodies may be made temporarily or permanently to change their form under the influence of mechanical forces. Thus a long leaden rod held by one end in a horizontal position is bent downward by its own weight. Flexibility, though not the opposite of brittleness, can not be predicated of brittle bodies.

Flexible Sandstone, sometimes called **Itacol'umite**: a metamorphic siliceous rock found in the Southern Alleghanies, and especially in Brazil. It occurs in thin layers, which are to a certain degree flexible, but are not elastic. Such sheets may be bent forward and backward hundreds of times without breaking. The cause of this peculiar property of itacolumite has been much discussed. Prof. Wetherell, of Philadelphia, after a careful microscopic examination of the granules of quartz which compose this rock, announced that he had discovered that they are elongated and interlocked, each particle working in a kind of joint. This statement has been denied by subsequent observers, but the weight of authority is in favor of its acceptance. Gold and diamonds are frequently found with itacolumite, and it has been thought that the association of the two latter was something more than accidental. No relationship has, however, been proved to exist between them.

Flexure [viâ Fr. from Lat. *flexura*, a bending, deriv. of *flectere, flexum*, bend]: the bending of a beam, plate, or column under the action of applied forces. The simplest instance is that of a beam supported at its ends in a horizontal position and loaded in the middle by a weight, where the action of the weight causes a deflection of the beam below its original position and generates stresses within it. If the weight be increased the deflection also increases, and the internal



Flexure of beam projecting from wall.

stresses finally become so great that rupture occurs. The theory of the flexure of beams enables the amount of deflection to be computed, provided that the internal stresses do not exceed the elastic limit of the material.

It is found by experiment that when a beam is subject to flexure one side assumes a concave and the other a convex form. The fibers on the concave side are compressed and those on the convex side are extended. Between the compressed and extended fibers lies a surface which is unchanged in length, called the neutral surface, and the intersection of this with a vertical plane is called the elastic curve. Thus a beam projecting from a wall, and loaded with a weight, *P*, at the end, as in the figure, has its upper surface convex and elongated, while its lower surface is concave and compressed. The neutral surface is $m\ n\ r\ s$, and the central line of this, $u\ v\ x$, is the elastic curve. The intersection of the neutral surface with a cross-section of the beam is called the neutral axis of that section; thus $m'\ n'$ is the neutral axis of the section $a'\ b'\ d'\ c'$. By the fundamental principles of statics it is proved that the neutral axis always passes through the center of gravity of a section, provided the elastic limit of the material be nowhere exceeded.

The practical discussion of a beam with respect to strength consists largely in the use of the formula

$$M = \frac{RI}{c}, \qquad (1)$$

in which M is the bending moment of the loads and reactions on one side of the section, c the distance of the remotest fiber of the section from the neutral axis, I the least moment of inertia of the cross-section, and R the unit-stress of tension or compression on the fiber distant c from the neutral axis. This formula, although only strictly true when the stress R is less than the elastic limit of the material, is often used for the rupture of beams, in which case R is called the modulus of rupture.

The following values of c and I for the most common cross-sections are needed in applying the above formula:

SECTION.	c	I
Rectangular	$\frac{1}{2}d$	$\frac{bd^3}{12}$
Square	$\frac{1}{2}d$	$\frac{d^4}{12}$
Circular	r	$\frac{\pi r^4}{4}$
Triangular	$\frac{2}{3}d$	$\frac{bd^3}{36}$
Hollow rectangular	$\frac{1}{2}d$	$\frac{bd^3 - b'd'^3}{12}$
Hollow square	$\frac{1}{2}d$	$\frac{d^4 - d'^4}{12}$
Hollow cylindrical	r	$\frac{\pi(r^4 - r'^4)}{4}$
I cross-section	$\frac{1}{2}d$	$\frac{bd^3 - b'd'^3}{12}$

in which b denotes breadth, d depth, and r radius, the same letters accented being the inner dimensions for the hollow sections; for the I section b' denotes the breadth minus the web thickness, and d' the depth minus the two flange thicknesses.

The average values of R, both for the case of rupture and for a safe degree of stability, are given in the following table in pounds per square inch:

MATERIAL.	Modulus of rupture.	WORKING UNIT STRESSES FOR—	
		Buildings.	Bridges.
Wood	9,000	2,000	1,200
Cast iron	35,000	5,000	3,000
Wrought iron	55,000	14,000	8,000
Steel	120,000	25,000	13,000

As an example of the use of the formula, let it be required to find what load will break a wooden beam 4 inches wide, 6 inches deep, and 108 inches long when supported at the ends and loaded in the middle. Here let the load be P; then the bending moment $M = \frac{1}{2}P \times 54 = 27P$, and $R = 9{,}000$ lb. per sq. inch, $c = 3$ inches, $I = 72$, and inserting all these in the formula there is found $P = 8{,}000$ lb.

The equation of the elastic curve of a beam and the amount of deflection are determinable by the theory of flexure, provided that the stresses in the material are within the elastic limit. If E be the coefficient of elasticity of the material, and x and y the linear co-ordinates of any point of the curve with respect to rectangular axes, the general equation of the elastic curve is

$$\frac{d^2y}{dx^2} = \frac{M}{EI}, \qquad (2)$$

in which M and I have the same significations as in formula (1). Applied to the case of a cantilever beam of length l having a load, P, at the free end, this becomes, for an origin at the free end,

$$6EIy = P(3l^2x - x^3),$$

which shows that the curve is a cubic parabola. If x be made equal to l the value of y is $\frac{Pl^3}{3EI}$, which is the deflection of the end of the beam due to the load P. The following table gives the values of the maximum bending moment and the maximum deflection for beams of uniform cross-section, W being the total load whether uniform or concentrated. It is seen that a concentrated load produces a

KIND OF BEAM AND LOAD.	Maximum moment.	Maximum deflection.
Cantilever beam, load at end	Wl	$\frac{1}{3}\ \frac{Wl^3}{EI}$
Cantilever beam, uniform load	$\frac{1}{2}Wl$	$\frac{1}{8}\ \frac{Wl^3}{EI}$
Simple beam, load at middle	$\frac{1}{4}Wl$	$\frac{1}{48}\ \frac{Wl^3}{EI}$
Simple beam, uniform load	$\frac{1}{8}Wl$	$\frac{5}{384}\ \frac{Wl^3}{EI}$
Beam fixed at both ends, load at middle	$\frac{1}{8}Wl$	$\frac{1}{192}\ \frac{Wl^3}{EI}$
Beam fixed at both ends, uniform load	$\frac{1}{12}Wl$	$\frac{1}{384}\ \frac{Wl^3}{EI}$

greater bending moment and a greater deflection than the same load uniformly distributed.

Columns.—If a column supports a load P the average compressive unit-stress upon it is $P \div A$, where A is the area of the cross-section. If the length of the column be considerable compared with its thickness, a slight sidewise deflection may occur, in consequence of which the compressive stress on the concave side becomes greater than the average value $P \div A$, and that upon the convex side becomes less. The exact determination of the maximum stress can not be made theoretically unless the deflection is known, but the subject is one of great practical importance, and many empirical formulas have been proposed for this purpose. The curve assumed by the central line of a column when thus subject to flexure is a sinusoid, and its equation is

$$y = \Delta \sin n\pi\frac{x}{l},$$

in which Δ is the maximum deflection, l the length of the column, y the deflection at a distance x from the end, and n is 1, 2, or 3, according to the number of times the sinusoid crosses the axis. The value of Δ, however, is indeterminate, and can not be expressed theoretically in term of the load.

A long column fails usually by sidewise flexure rather than by direct compression, and the load which causes incipient failure is given by the formula

$$P = EI\frac{n^2\pi^2}{l^2},$$

in which n and l are as just defined, E is the coefficient of elasticity of the material, and I is the least moment of inertia of the cross-section. If the load be less than this formula gives, the deflection of the column tends to decrease; if it be greater, the deflection tends to increase, and in this sense P is the load which causes the failure.

HISTORY AND LITERATURE.—The problem of the flexure of a beam was first discussed by Galilei in 1638; he regarded the fibers as inextensible, but nevertheless some of his conclusions were correct. Hooke's discovery of the law of elasticity in 1678 rendered it possible for a better theory to be developed, and this was done during the following fifty years by Mariotte, Varignon, and others. The elastic curve was first investigated by James Bernouilli in 1694, but its complete practical application was not made until the subject was treated by Navier more than a century later. Among those who have made important contributions to the theory of flexure during the nineteenth century may be mentioned Lamé, Saint-Venant, Clapeyron, and Weyrauch. The flexure of columns was first treated by Euler, and little theoretical advance has since been made. A synopsis of writings on the theory of flexure previous to 1850 is given in Todhunter's *History of the Theory of Elasticity* (1886). In modern text-books the subject is usually treated in works on the resistance of materials. Among these may be mentioned Wood's *Resistance of Materials* (1875); Merriman's *Mechanics of Materials and of Beams, Columns, and Shafts* (1885); and Church's *Mechanics of Engineering* (1889). The flexure of continuous beams is fully developed in Weyrauch's *Theorie der einfachen und continuirlichen*

Träger (Leipzig, 1873). See also BRIDGES (*Continuous Bridges*), GIRDER, MOMENT, STATICS, and STRENGTH OF MATERIALS. MANSFIELD MERRIMAN.

Fliedner, fleet′ner, THEODOR, D. D.: philanthropist, and founder of the institution of Protestant deaconesses; b. at Eppstein, Prussia, Jan. 21, 1800. He studied at Giessen, Göttingen, and Herborn, was for one year tutor in a family at Cologne, and in Nov., 1821, accepted a call from a small Protestant colony at Kaiserswerth, a Roman Catholic town of 1,800 inhabitants on the Lower Rhine, below Düsseldorf. The failure of a silk-factory having soon afterward thrown most of his parishioners out of employment, to relieve their distress he started on a tour for the solicitation of charity, and had soon collected a considerable sum. In June, 1823, he made a tour to Holland and England, which not only resulted in a permanent endowment of his congregation, but suggested to him the idea of founding benevolent institutions in his own country. Accordingly, upon his return he set on foot a number of charitable projects, the most important of which was the establishment of the House of Deaconesses at Kaiserswerth.

King Frederick William IV. of Prussia and his queen Elizabeth took much interest in his labors for the sick and poor, granted him several audiences, furnished him liberally with means, and founded a Christian hospital with deaconesses at Berlin (Bethany) after the model of Kaiserswerth.

Fliedner made two more journeys—to Holland, England, and Scotland (in 1832 and 1853), in the interest no more of his congregation, but of his institutions. He also visited the U. S. in 1849. Twice he traveled to the East—in 1851, to aid Bishop Gobat in founding a house of deaconesses in Jerusalem, and again in 1857, when he was, however, too feeble to proceed farther than Jaffa. D. at Kaiserswerth, Oct. 4, 1864.

Fliedner's Institutions.—The most important of these is the institution of Evangelical Deaconesses, founded in 1836. It was intended to be, and is in some sense, a revival of the apostolic office of deaconesses which continued in the Church for several centuries, but it resembles more the active sisterhoods of the Roman Church, and may be regarded as a Protestant counterpart of the Sisters of Charity, divested of all ascetic and monastic features. The apostolic deaconesses, such as Phœbe, were congregational officers, and visited the sick and the poor at their homes. The Kaiserswerth deaconesses may also be employed for parochial activity (*Gemeindepflege*), but they are usually connected with hospitals, orphan asylums, prisons, and other public institutions.

With the House of Deaconesses at Kaiserswerth are connected a hospital, an infant school, an orphan home, and an asylum for insane females. In 1850 more than sixty Kaiserswerth deaconesses were at work in different places. At the time of Fliedner's death the number of deaconesses exceeded 400, and in 1890 about sixty institutions similar to that at Kaiserswerth were reported, with about 6,000 sisters. In the Austro-Prussian war of 1866 the various deaconess houses of Germany furnished 284 nurses to the military hospitals, besides receiving a large number of sick and wounded into their own establishments; and of these nurses forty-six were from Kaiserswerth. The mother house fulfills the mission of a large normal school for the training of women to the care of the poor and suffering, and has given rise to many similar institutions in Germany and other lands. There Florence Nightingale was inspired for her noble mission in the Crimean war, and Dr. Passavant for the establishment of a Christian hospital in Pittsburg.

LITERATURE.—Fliedner, *Collectenreise nach Holland* (2 vols., Essen, 1831); *Buch der Märtyrer der evangel. Kirche*, (1852, *seq.*, with a supplement, in 3 vols.); *Kurze Geschichte der Entstehung der ersten evang. Liebesanstalten zu Kaiserswerth (des Asyls. der Diakonissen-Mutter-Hauses und des Hospitals)* (1856); Jul. Disselhoff (Fliedner's successor), *Nachricht über das Diakonissenwerk in der christlichen Kirche . . . und über die Diakonissen-Anstalt zu Kaiserswerth* (5th ed. 1867); Catherine Winkworth, *Life of Pastor Fliedner of Kaiserswerth* (translated from the German, which first appeared in the *Kaiserswerth Almanac* for 1866), London, 1867); Florence Nightingale. *Account of the Institution for Deaconesses* (London, 1851); Dean Howson (of Chester), *Deaconesses* (London, 1862); W. F. Stevenson, *Praying and Working* (1862; republished in New York); J. M. Ludlow, *Women's Work in the Church* (London, 1866); also the annual reports and other periodical publications of Kaiserswerth. Revised by S. M. JACKSON.

Flies: See FLY.

Flint [O. Eng. *flint*: Dan. *flint*, stone, flint, gun (whence Germ. *Flinte*, gun); cf. Gr. πλίνθος, brick]: a variety of quartz, massive, dull-colored, and dark, with translucent edges, found especially in nodules in chalk-beds, and on microscopic examination found to consist largely of the fossil frustules of diatoms, the spiculæ of sponges, and the like. Its nodules frequently inclose a large fossil. Specific gravity, 2.6. In prehistoric times it was extensively used as the material for knives, arrow-heads, and other weapons, its peculiar conchoidal fracture and sharp edges fitting it well for such uses. Its use for kindling tinder by striking fire with steel is a thing of the past, as is its employment for a similar use in firearms. Flint is employed in making some kinds of glass, and ground flints are an ingredient of porcelain-ware. Flint is in some places used as a building-stone. In the U. S. the hornstones of the Palæozoic limestone strata pass into flint, and have been shown to be of precisely similar origin to the true Cretaceous flint.

Flint: seaport and parliamentary borough; Flintshire, North Wales; on an arm of the Dee river; 13 miles N. W. of Chester (see map of England, ref. 8–F). It has a large trade, exporting coal and lead from extensive mines near by, and importing much lumber. It contains remains of ancient intrenchments and of Flint Castle, built by Edward I., and dismantled in 1647, and is noted as the place where Richard II. surrendered to Bolingbroke in 1399. Pop. (1891) 5,247.

Flint: city; capital of Genesee co., Mich. (for location, see map of Michigan, ref. 7–J); on Chi. and Gr. Trunk and Flint and P. Marq. R. Rs.; 61 miles N.W. of Detroit. It is the seat of the Michigan Institution for the Deaf and Dumb and of Oak Grove Home, a private institution for the care of mildly insane persons. The city has a large union schoolhouse, a ladies' library association, a large number of steam saw-mills (manufacturing about 50,000,000 feet of lumber annually), gas and electric lights, water-works, etc. Pop. (1880) 8,409; (1890) 9,803; (1900) 13,103. EDITOR OF "NEWS."

Flint, AUSTIN, M. D., LL. D.: physician and author; b. in Petersham, Mass., Oct. 20, 1812; graduated in the medical department of Harvard University 1833; was one of the founders of the Buffalo Medical College, and Professor of Theory and Practice in it from 1847 to 1853; also established the Buffalo *Medical Journal*. In 1844 he was called to the Rush Medical College in Chicago. He occupied for four years the chair of Theory and Practice in the medical department of the University of Louisville, and for three winters (1858–61) was Professor of Clinical Medicine in the New Orleans School of Medicine. He removed to New York city in 1859, was made one of the attending physicians to Bellevue Hospital, and appointed to the chair of Principles and Practice of Medicine and Clinical Medicine in the Bellevue Hospital Medical College, a position he held till his death, and from 1861 until 1868 was a professor in the school of the Long Island Medical College Hospital. From 1872 until 1885 he was president of the New York Academy of Medicine. Dr. Flint was the author of many standard works in the profession. He published the clinical reports *On Continued Fever* (Buffalo, 1852); *Chronic Pleurisy* (1853); and *Dysentery* (1853); *Physical Exploration in the Diagnosis of Disease of the Respiratory Organs* (Philadelphia, 1856; 3d ed. 1868); *Diseases of the Heart* (1859–70); *Principles and Practice of Medicine* (1866; 5th ed. 1881); *Essays on Conservative Medicine and Kindred Topics* (Philadelphia, 1874); *Clinical Medicine* (1879); *Physical Exploration of the Lungs by Means of Auscultation and Percussion* (1882). D. in New York, Mar. 13, 1886.

Flint, AUSTIN, M. D., LL. D.: physician; son of Austin Flint; b. in Northampton, Mass., Mar. 28, 1836; was for one year at Harvard; 1854–56 at University of Louisville, Ky.; graduated from the Jefferson Medical College, Philadelphia, 1857; editor of Buffalo *Medical Journal* 1857–60; Professor of Physiology and Microscopic Anatomy, University of Buffalo, 1858–59; became Professor of Physiology in New York Medical College 1859, and in New Orleans Medical School 1860; studied in Europe under Bernard and Robin, and in 1861 became Professor of Physiology and Microscopical Anatomy in Bellevue Hospital; has held the chair of Professor of Physiology in Long Island College Hospital 1862–68; and has been connected with other institutions as consulting and visiting physician. His chief works are *Physiology of Man* (5 vols., 1866–74); *Chemical Examination of Urine in Disease* (1870); *Effects of Severe* *and Protracted Muscular Exercise* (1871); *Service of Muscular Power* (1878); *Text-book of Human Physiology* (1875). In addition to these he has written a large number of pamphlets, memoirs, etc., on professional subjects.

Revised by C. H. THURBER.

Flint, ROBERT, D. D., LL. D.: a theologian of the Church of Scotland; b. near Dumfries, 1838, and educated at Glasgow. He was in the pastorate 1859–64, was Professor of Moral Philosophy and Political Economy at the University of St. Andrews 1864–76, and then became Professor of Divinity in Edinburgh University. Among his published works are *The Philosophy of History in France and Germany* (Edinburgh, 1874); *Theism* (Baird lectures for 1876–1877; seventh ed. revised 1893); *Anti-Theistic Theories* (Baird lectures for 1877; 1879 and three subsequent editions).

Flint, TIMOTHY: clergyman; b. in Reading, Mass., July 11, 1780; graduated at Harvard University in 1800; was a Congregational minister at Lunenburg, Mass., from 1802 to 1814; was missionary in the Mississippi valley, and was afterward farmer and teacher at Cincinnati, O., and in Louisiana. Returned to Massachusetts in 1825; from 1825 till 1828 edited at Cincinnati the *Western Review*. In 1833, at New York, edited the *Knickerbocker*; in 1827–30 edited *The Western Monthly Magazine*; subsequently lived in Alexandria, Va. He published *Geography and History of the Western States in the Mississippi Valley* (1828), besides various novels (the best known of which is *Francis Berrian*, 1826); *Lectures on Natural History*, etc. D. in Salem, Mass., Aug. 16, 1840.

Flint Glass: one of the varieties of glass which contain a large percentage of lead. Powdered flint was formerly used in the manufacture, whence the name. The best of white sand (51 parts), a tolerably pure carbonate of potash (16 parts), minium or litharge (28 parts), and saltpeter (4⅔ parts) are used as principal ingredients; a little manganese, arsenic, baryta, and lime are added to correct any discoloration. Flint glass is used largely in the manufacture of achromatic lenses, and grades inferior to the very finest are used in making bottles, table-ware, and other glass goods, either blown or molded. The Venetian and Bohemian glass articles are especially celebrated. See GLASS.

Flint Implements: See STONE, AGE OF.

Flint River: a river of Georgia; rises in Clayton County and flows first in a S. S. E. and then in a S. S. W. course to the S. W. corner of the State, where, joining the Chattahoochee, it forms the Appalachicola river. It is 300 miles long and navigable during high water to Albany by light-draught steamers, and at all times by larger steamers to Bainbridge, 50 miles from its mouth.

Flint River: a river of Michigan; rises in Lapeer County; flows 100 miles W. and N. W., and falls into the Shiawasee, an affluent of the Saginaw. Its lower part is navigable.

Flintshire: maritime county of North Wales; situated between the Irish Sea and the river Dee; area, 253 sq. miles. The coast is low and sandy, except along the estuary of the Dee. Parallel with the Dee runs a range of hills, rising in Garrey to 825 feet. The plains and the vales are fertile, and produce wheat, oats, and barley. The hills yield coal and ores of iron, zinc, copper, silver, and especially lead; one-fourth of the lead produced in Great Britain is supplied by Flintshire. As the county has a mild climate, moderate elevation, and shelter, it is well adapted to agriculture, and three-fourths of its area are under cultivation. Cotton is the main manufacture. Flint, Mold, St. Asaph's, and Hawarden are the chief towns. Pop. (1901) 81,487.

Flipart, flee'paar', JEAN CHARLES: engraver; b. in Paris in 1700. His best works are a portrait of René Chopin, after Jacnet: *The Virgin and Child* and *Christ in the Garden of Olives*, after Raphael; also *The Penitent Magdalen*, after Lebrun; and *Apollo Teaching Daphne*, after René Houape, for the Crozat collection. He was father of JEAN JACQUES FLIPART (b. in 1723; d. 1782), more famous than himself, and of CHARLES FRANÇOIS FLIPART, both engravers who learned their art of him; the former was also a painter and a skillful draughtsman, and left many engravings after Greuze, Giulio Romano, Natoire Vier, and Dietrick and others.

W. J. S.

Floating Batteries: See SHIPS OF WAR.

Floating Breakwater, Docks, etc.: See BREAKWATER, DOCKS, etc.

Flodden Field: the last point of the Cheviots, the place where King James IV. of Scotland, after crossing the Border on Aug. 22, 1513, with an army of over 30,000 men, encountered the Earl of Surrey at the head of an English army of 32,000 on Sept. 9. The battle was stubbornly contested till after nightfall, but resulted in the complete defeat of the Scottish army, and the loss of from 5,000 to 12,000 men, including the king and many of the nobility.

Flodoard, flō'dō'aar', or **Frodoard**: Canon of Rheims; b. at Épernay, 894 A. D.; opposed the intrusions of the civil power into the affairs of the Church, and was imprisoned therefor; author of French annals (*Chronicon*, 919–966); a history of the Rhemish Church; the *Triumphus Christi*, a metrical work, etc. He became an abbot, and died Mar. 28, 966. *Chronicon* is valuable to the historian. Large portions of his writings are extant, and have been printed.

Floeberg Beach: See the Appendix.

Floersheim, OTTO: journalist and composer; b. in Aix-la-Chapelle, Mar. 2, 1853; studied there under local teachers, and then at Cologne under Ferdinand Hiller; went to New York in 1875, and contributed musical articles and criticisms to various German periodicals. In conjunction with Marc A. Blumenberg he established the *Musical Courier*, to which he has since confined his writing. In 1892 he returned to Germany, where he still remains (1893). His compositions comprise orchestral pieces, songs, and pianoforte pieces.

D. E. HERVEY.

Flogging: the infliction of stripes or blows by a whip or scourge, especially when directed by a court of justice or other public authority. Corporal punishment has from the earliest ages been inflicted as a punishment for various offenses. In the form of the bastinado it is still extensively employed in the East. In ancient Rome scourging might not be administered to a citizen, for it was looked upon as giving the deepest dishonor to its victim. It was, however, frequently employed as a punishment for those who were not citizens, and was administered with a rod. In modern Europe it is not quite extinct; in many places where it had been abolished it has been reintroduced. Its severest form is by the knout in Russia, where it is much less frequent and severe than it formerly was. In Great Britain it exists as a means of prison discipline, but has been abolished in the army and navy. In the U. S. army and navy it has been abolished, as well as in most of the States, Delaware being a noteworthy exception.

Flood, Rt. Hon. HENRY: orator; b. in Ireland in 1732; educated in Dublin and Oxford; first entered the Irish Parliament in 1759; was sworn a member of the privy council for Great Britain as well as for Ireland in 1775; was vice-treasurer of Ireland, 1775–81; and entered the British Parliament in 1783. His speeches are noteworthy for their fine style and logical method. He was an eloquent advocate of reform for Ireland, but the purity of his motives has been questioned. Author of some poems and a volume of *Speeches* (1787). D. at Farmley, Ireland, Dec. 2, 1791. See his *Life and Correspondence*, by W. Flood (1838.)

Flood-plain: a broad river-made plain, formed by successive layers of silt, sand, or gravel, at times of river overflow. The even surface of the plain commonly ascends very gently from either margin to the river-banks, where the greater amount of deposit is laid down by the overflow. For this reason settlements are often made on the higher ground close to the river, to avoid the "back swamps"; for the same reason lateral tributary streams emerging from higher land frequently turn down the flood-plain for many miles before entering the main river. A river meanders or swings in a serpentine course through an alluvial flood-plain, the radius of its curves increasing with the volume of the stream. The current cuts away the concave bank and builds out the convex bank, and thus the channel shifts about the plain. Narrow necks of land between meanders are often cut off, leaving an abandoned channel as a stagnant "ox-bow" lake. The flood-plains of the the lower Mississippi (mapped by the Mississippi River Commission), Amazons, middle Rhine and Danube, lower Po, Nile, and Ganges are well known. They are extremely fertile, and are generally covered in the natural state by swampy forests or meadows. When occupied by man, protection by dykes or levees is needed against overflow. Gravelly flood-plains are made by rivers emerging from a steep course among lofty mountains upon a lowland; the river then splits into a network of shifting channels, like those of the Duranse in Southeastern France or the Tagliamento in Northern Italy. See RIVERS, DELTA, and LAKES.

W. M. DAVIS.

Floods: temporary invasions of the land by bodies of water. Coasts of seas and lakes are sometimes inundated. By the bursting of dams, artificial or natural, the water of reservoirs deluges neighboring valleys. Most rivers, either periodically or occasionally, are so enlarged as to spread beyond their banks.

Coastal Floods.—Floods sometimes occur along coasts from the wave accompanying an earthquake. During the great Lisbon earthquake of Nov. 1, 1755, a wave rushed over the land covering it to a depth of 80 feet, causing great destruction. They are also caused by the storm-waves accompanying tropical cyclones of great energy. Such was the Backerganj flood from the Bay of Bengal. The delta of the Ganges river was inundated to a depth of 40 feet, and more than 100,000 lives were lost. Floods of this nature, but less intense, occur at rare intervals along the coast of Texas. Of nearly the same nature are the floods that sometimes devastate Holland. A great part of the country is protected by dikes from the encroachment of the sea. Violent storm-winds heap up the sea, which in some cases overtops or breaks the dikes.

Floods due to rise of lake-level occur only over restricted areas, and are of slight importance. They result from more than the usual amount of rainfall in a season, and occur only on some of the lakes of Central Asia. The rises are slow and not very great, and but little damage is ever done. Of the class of lake floods, however, seiches are important. A seich is a sudden rise of the water surface, or a slow moving wave. On the Great Lakes of the U. S. the rise sometimes is as great as 6 feet, and at times causes great damage.

Reservoir Floods.—A very important class of floods is that due to the bursting of reservoirs, from the giving way of embankments, the yielding of ice-dams in rivers, and the releasing of glacier lakes. The Johnstown flood of May 31, 1889, in Western Pennsylvania, was a memorable example of the first kind of flood. The breaking of the dam of the South Fork reservoir precipitated a volume of water 3 miles long, a mile wide, and 100 feet deep, on the valley below, destroying everything in its course for a distance of 18 miles and killing 5,000 people.

At the breaking up of ice in the spring river channels sometimes become blocked by the accumulation of ice in bends or narrow parts of the river, or at places obstructed by bridge piers. The water backs up behind the dam or ice-gorge thus created, causing damage above it and also below it when the barrier breaks. Floods of this class, however, do not usually prove very destructive. If foreseen they can in many cases be provided against. The greatest loss is commonly to boating interests, damage being done to craft that can not be gotten out of the way. Ice-jam or ice-gorge floods may cause great damage in a flat country.

A flood of a peculiar kind sometimes arises from an advancing glacier crossing and blocking a stream and creating a glacier lake back of it. This occurs at times in Switzerland, and more frequently in the region of the Himalaya mountains in Northwestern India, especially on the tributaries of the Indus. In the valley of Bagnes, south of Martigny, the winter of 1818 being very severe, the Gintroz glacier advanced and blocked the Drause river, making a lake back of it a mile long, 700 feet wide, and 200 feet deep. The ice was pierced artificially and the lake about half drained off when the barrier broke and caused a great flood.

River Floods.—The most frequently occurring floods are river floods due to overflow of river-banks caused by inadequacy of river channel to carry off the rainfall water as fast as supplied. Rivers are a product of rainfall. The periodicity of rainfall over a country is reflected in the rise and fall of its rivers, sometimes nearly dry and at others overflowing their banks. Floods in rivers are rarely the result of a single great downpour of rain, except over a very restricted area of a few hundred square miles in extent. They are usually the result of a series of moderate rainstorms gradually filling the river channels until there is an overflow. A very disastrous but rare species of river flood occurs when a river cuts its banks, taking an entirely new course to the sea. This has occurred on the delta of the Hwang Ho in China on nine occasions in historical times. In 1853 the river broke from its course and entered the Yellow Sea, 350 miles farther north than formerly, entailing enormous loss of life through drowning and starvation. See CHINA and YELLOW RIVER.

In the most common species of flood, where the water rises gradually and overflows the low-lying lands, damage occurs from the submerging of property, the destruction of growing crops, and the impossibility of working the land in time to raise a harvest. At times buildings are destroyed, cattle are drowned, and human lives lost. In cities subject to overflow great damage is at times wrought to merchandise. Railroads are flooded, bridges carried away, commerce is impeded, and business interrupted.

The amount of rise above low water that will produce overflow is different in different rivers, and also along different parts of the same river. The overflow stage varies from 20 feet or less in some rivers to as much as 86 feet in others.

Run-off.—Of the rain that falls a part goes directly into the rivers; a part sinks into the ground and flows out slowly through springs at a lower level than it entered. A great part of what sinks into the earth evaporates into the air, either directly or through the vital processes of plants. About one-fourth of all the rain that falls reaches a depth of 3 feet in the ground. The depth of water in the ground to bed-rock is about one-third of the depth of the soil covering the rock. Thus only a part of the rain reaches the rivers and the sea. The proportions vary greatly in different regions, and even for the same region in different seasons and different rainstorms. The average run-off for rivers of the temperate zone is about one-fourth of all the rainfall. For the drainage area of the Darling river in the dry climate of Australia the run-off is on the average only 1·5 per cent., some years being as low as 0·1 of a per cent., and in others as high as 6 per cent. The run-off varies greatly with the permeability of the ground. Some soils absorb the water more readily than others. In the case of snow on hard-frozen ground the run-off may be 75 per cent. of the melted snow. In the case of hard-frozen ground covered with glare ice by a light rain, the run-off in the case of a succeeding heavy rain may be as much as 90 per cent. The greater the rate of downpour of rain the greater the run-off; the water not sinking into the earth rapidly forms a thin layer over the surface, which promotes the rapid transfer of a great part of it to the streams. After a season of drought, a month or more with little or no rain, it requires a fall of 2 or 3 inches of rain to saturate the ground. Such a rain falling slowly might produce no effect on a river, but if it fell in a few hours it might produce a great rise. The estimated flow of water from all the land surface of the earth is 7,000 cubic miles annually. The outflow of the Mississippi river is 120 cubic miles annually on the average, and 200 in flood years. The outflow of the Amazon is 600 cubic miles.

Levees.—River floods are not without beneficial effects on the land overflowed. The fine silt deposited renders it very fertile. Alluvial land is therefore highly prized, but when it has once become occupied by the farmer the flooding by which it was originally enriched becomes an impediment to its utilization. Protection from overflow is commonly sought by embankments called levees. Along the lower course of the Mississippi river, below the junction of the Ohio, there is an area of 30,000 sq. miles subject to overflow which is protected by 1,300 miles of levees. The yield of cotton and sugar from this region is large, and when the water breaks over the levees, as it sometimes does, the damage is great. The whole area is never flooded at the same time. Were it not for the levees a great part of the area would be flooded every year.

The levees do not entirely prevent floods, but greatly diminish their frequency. The greatest high waters that occasionally occur override everything. Breaks in a levee are known as crevasses. When the water once gains an outlet through a levee it carries away the earth of the embankment very rapidly, deepening and widening the break every instant, until it is hundreds of feet wide, and in some cases even miles in width. When crevasses occur, the first care of the levee engineers is to secure the ends of the opening and prevent the break extending. Crevasses are sometimes successfully closed.

Levees are apt to break when from long contact with high water the embankment becomes softened by the water percolating through. When the water is near the top, wave-wash caused by high winds is a source of danger. Crevasses are sometimes attributed to crawfish. Improperly laid rice-flumes are apt to be a source of weakness and make a starting-place for water to come through. During the continuance of high water vast interests may be at the mercy of the slightest accident to the levees. See LEVEE and RIVERS.

Mode of Occurrence of High Water.—High waters in rivers occur in various ways in different parts of the world, depending on the climate, the annual distribution of rainfall, the temperature, and especially on the topographical features of the drainage areas of the rivers, particularly the slope of the ground and the way different tributaries combine to form a great river. Of the dependence of river floods on meteorological laws little more is known than that certain high waters depend on the rains of the equatorial belt of calms, on the rains associated with the bursting of the monsoons, and on the locking of water by frost in northern latitudes.

Rivers may be roughly classified according to the way high water occurs. In land-locked areas the rivers flow to the lowest part of the drainage basin and form a lake. The water rises to the lowest part of the inclosing ridge, provided the evaporation from the lake surface is less than the inflow, and overflows as a river to the sea. In rivers that take their rise in lakes the flow of water is nearly constant, and there is very little variation of stage, year in and year out. Floods never occur on these rivers. The variation in the height of the St. Lawrence river, which takes its rise in Lake Ontario, ordinarily is only 4·5 feet. High winds cause variations of a few feet from the extremes of low and high water lake-levels which, however, last for only a short time.

In the rivers of Siberia and British America that flow into the Arctic Ocean high water occurs as the result of snow melting in the spring along the lowlands and up to a height of 3,000 feet above the level of the sea. The rivers flow from south to north. The Obi, Yenessei, and Mackenzie are of this type. Along the upper courses the snow melts first. As the water flows down it is met by the water from the snow farther north melting later. The consequence is excessive high waters along the lower courses of these rivers, and great areas of land are flooded. The blocking of river-channel by the formation of ice-gorges also adds greatly at times to these floods.

One class of rivers derive their water almost exclusively from snow melting in the mountains. The melting is a slow process, and high water occurs gradually and with great regularity. The Indus, which rises in the Himalaya Mountains, is a river of this type. The Rocky Mountain region of the U. S. abounds in small streams of this kind. In some instances such rivers show a small diurnal fluctuation of stage corresponding to the greater melting of snow that takes place in the day as compared with the cooler night.

Rivers in the tropical countries receive water from rainfall only, and have high water in summer. The greatest rivers of the world belong to this class, the Amazon, the Congo, the Ganges, the Yang-tse, and the Nile. In some of these rivers the high waters depend on the rains of the belt of calms at the equator. In those of Asia the rises come from rains that occur at the bursting of the monsoon. The Amazon does not vary greatly at different times of the year, because when the northern tributaries are in flood the southern ones are low, and when the southern ones are in flood the northern ones are low. The great floods of the Yang-tse sometimes last from June to December. The rises show that the monsoon winds penetrate to the interior of Asia to a greater extent than was at one time supposed.

In rivers that are dominated by the sub-tropical rains—that is, little or no rain in summer-time—the rivers are low or nearly dry in summer, and high water occurs in winter. The rivers of Italy and Spain are of this class, also the rivers of California and Oregon. These latter, however, derive some water from melting snow in the mountains. Rivers of the temperate zone receive their main supply of water from rains directly, and are high in winter and spring, the seasons of great rainfall. Of this class are the Elbe, Rhine, and Seine of Europe, the Ohio, Arkansas, and Mississippi in the U. S. High water in these rivers is added to very materially at times by the melting of accumulated snow. The smallness of evaporation in winter as compared with summer tends to make the water high.

Some rivers receive most water from rain, but high water is due to the additional amount coming from melted snow. Melted snow is relatively more efficient than the same amount of rain in causing a rise, because a much greater part of it goes into the rivers when melted, frozen ground being impermeable to water. The rivers of New England are of this type. With great depth of snow on the ground, floods occasionally occur in some rivers not otherwise subject to overflow. About once a century the river Somme in France overflows from this cause. The flood of 1658, which was preceded by several weeks of excessively cold weather, came from the melting of snow which lay on the ground to the depth of 6 feet. Preceding the great flood of 1740 the conditions were similar.

High water, besides depending on great rain, depends also on the topographical features of the drainage area in combination with the sequence of rainfall over its different parts. Rainfall is not usually uniform in depth over a wide area in great rain-storms. When the distribution of a fall of rain in time and space is such that the freshets in tributaries from several regions coincide in reaching the main channel of a river at the same time, excessively high water results.

Floods in the lower Mississippi river are due mainly to water from the Ohio river. The Ohio alone is not sufficient to cause a stage of more than 40 feet in the lower Mississippi. To carry it 8 feet farther to the flood-line requires that the Arkansas, the Missouri, or the upper Mississippi shall send out a flood to be opportunely superposed on the high water from the Ohio. Variation in distribution of rainfall in different years may cause flood-waves from the various tributaries to pass through the lower river in succession, producing moderately high stages of water lasting a long time, but no great high water.

For any particular river many different combinations of flood-waves from the various tributaries are possible, so that the occurrence of a flood may in a certain sense be considered as fortuitous. Caution has therefore to be exercised in passing from records of high water to conclusions as to changes in river regimen and increased flood-heights due to extension of land cultivation or the clearing of forests.

Forests and High Water.—Where forests are cut away from a drainage area, especially on hillsides, the amount of silt carried to the streams is increased. By filling up the bed of a river this may cause the heights of high waters to gradually increase without any greater quantity of water passing through the river. A notable case of rising of river-bed due to deposit of silt is that of the Sacramento river. This, however, is not due to cutting away of the forests, but to the washing down of mining *débris*. The rise in bed of river, which is 20 feet higher now than it was in 1849, is partly due to restricted tidal scour caused by reclaiming of overflowed land by levees. Bushes that grow spontaneously on hillsides are as serviceable as forests in checking soil waste and consequent clogging of streams, so there is no necessity to plant trees. That forest over a drainage area diminishes the flood-heights of its rivers by conserving the rainfall, and causing it to pass to the streams more slowly, is highly improbable. That forests have any influence in increasing or diminishing rainfall has never been proved. That forests do conserve the water by diminishing evaporation, giving greater outflow at low water, and preventing the occurrence of very low stages or the absolute drying up of streams, seems very likely.

Records of River-stages.—Daily records are kept of the stages of water in rivers at various places. A river-stage is the vertical height in feet of the river-surface above the local plane of low water. The stage of water is ascertained by means of a river-gauge, which usually consists of timbers or stones suitably graduated, laid along the incline of a river-bank. When a bridge pier is available, a gauge is made of a graduated plank fastened to it vertically or by the cutting of marks on the stone. River-stage observations are mainly valuable at very high stages of a river in case of a threatening flood; they are also of use at the lowest stages of water, as indicating available channel depths for boating.

A flood condition in a river is sometimes graphically presented to the eye by a device called a hydrograph. On a sheet of cross-section paper the squares from left to right are taken to represent successive days, and the squares from below upward are taken to represent units of gauge height. The gauge readings for the days are then plotted as points, and these are joined by a curve, which is called a hydrograph. In this way a rise in a river at a place is shown on paper as a wave. There is a gradual increase in height to the highest stage or crest and then a falling off. A hydrograph exhibits the condition of a river at only one point. To show the conditions all along a river requires hydrographs for a great many points. Another method of graphically showing a flood condition in a river is by means of isopleths. On a sheet of cross-section paper the squares from left to right represent successive days; the squares up and down represent distance of various places along the river from some initial point. On the line for a place there is written in for each day in figures the number of cubic feet of water per second passing the place on that day. Lines are drawn through the points of equal quantity of water discharge for discharges differing by 100,000 cubic feet or so. These lines are called isopleths. In this way a graphic relief chart is produced which shows a flood-wave along a river.

Another method of representing a flood is to write in place of the discharge of water, as described above, the stage of water on the day expressed as a percentage of the total range in stage from low to high water. Joining the points of equal percentages by lines, say 10 per cent. apart, a chart is obtained which shows the magnitude and movement of a flood-wave.

Flood-wave Movement.—The greater the drainage area above a place the slower and more regular the rise and fall of the water. Where the drainage area is not more than 200 sq. miles the rise and fall runs its course in a day or a few hours, especially if the country is hilly. With a drainage area of many thousand square miles, as in the case of Pittsburg, for instance, with 17,000 sq. miles above it, the rise and fall on the average covers about six days. For Cincinnati, with 71,000 sq. miles above it, the time is fourteen days; for Vicksburg, with an area of 1,137,000 sq. miles above it, the time may be forty days or more.

A flood-wave in a river moves down stream with a moderate velocity, from 3 to 5 miles an hour, which renders it possible to foretell the occurrence of high water along the lower course of a river when the rises along the upper course are known. There is a dependence of the stage at one place with that of another above it. Warnings of a coming high water can be given by telegraph in many cases to interested districts a considerable time ahead. Such warnings have become of great importance.

So long as the water remains in the channel the rate of progress of a flood-wave crest does not differ materially from the velocity of the water forming it. When the water overflows the banks the wave-crest time is very much retarded. The wave-crest velocity is also retarded as compared with the velocity of the water, from the fact that the empty river channel has to be filled as the river rises. The time of a flood-wave crest in the Ohio river, from Parkersburg to Cincinnati, a distance of 286 miles, is three days; from Cincinnati to Cairo, 498 miles, it is six days. On the Mississippi river, from Cairo to Vicksburg, 599 miles, the time of crest-wave travel is seven days while the river is within banks; when the river overflows it may be as great as twenty days.

River-stage Predictions.—The following account of the method employed in the prediction of river-stages is based primarily on the usage of the U. S. Weather Bureau:

For two places on a river 100 miles or so apart, with no large tributaries coming in between them, the relation of the gauge readings for the two places is derived as follows: From the records of stages the highest stages reached during rises at the upper place are selected, and also the corresponding highest stages occurring a day or so later at the lower station. By taking the averages of corresponding stages for the two places in groups differing in stage about 5 feet, a series of corresponding values for the two places is derived. These are arranged in the form of a table, or a curve is made with the stages at one of the places as abscissas and the stages at the other as ordinates. From this the high water that may be expected at a place can be derived when the high water that occurs earlier at the place above it is known. For Cincinnati and Louisville, for instance, on the Ohio river, 132 miles apart, a 40-feet crest stage on the gauge at Cincinnati corresponds to 16·9 feet one day later at Louisville; 50 feet correspond to 26·0 feet; 60 to 38·2; and 70 to 46·4. These are the averages. The individual cases may differ a foot or two. The relation of the gauges is closer the nearer the two gauges are together and the less the quantity of water coming into the river from tributaries between them. In some cases better results in the prediction of stages are obtained from the comparison of corresponding rises rather than by corresponding stages. In case the rise at a place is the result of rises in several large tributaries, the best method of deriving a rule for predicting the highest stage is to compare the rise at the place with the rises preceding it at places on the tributaries. At Cairo, Ill., for instance, on the Ohio river, a rise may be the result of a rise in the upper Mississippi river as shown by the river-gauge at St. Louis, a rise in the Wabash as shown by the Mt. Carmel gauge, a rise in the Ohio river as shown by the gauge at Cincinnati, or on rises in the Cumberland or Tennessee as shown by the gauges at Nashville or Chattanooga.

The higher the stage at a place the greater the effect of a rise in causing a rise at places below it, on account of the greater quantity of water passing. For high stages at a lower station, rises at upper stations are not as effective in producing rises as when the stage at the lower station is low. The greater area of cross-section of a river and the greater velocity of the water at a high stage require a greater quantity of water to produce a given rise at a high than a low stage. In deriving prediction rules it is considered that for a place the rises multiplied by the mean stages during the rises are comparable throughout different stages. This is taken as a rough approximation to the truth where there are no local discharge measurements to give exactly the relation of rises at different stages.

In case the rise in a tributary stream at a place near its mouth is partly due to back water from a rise in the main stream, the rise multiplied by mean stage during the rise is not a measure of effectiveness in producing a rise farther down, and allowance has to be made for it.

From observations of stages at a single place, some idea can be formed of a coming stage of high water. The difference of stages gives a rate of rise which can be used in calculating a stage for some time ahead. When the rate of rise is diminishing, it is a sign that the crest of the wave or greatest stage of water is near at hand.

Rainfall and River Rise.—Observations of rainfall over a drainage area are of little practical value in estimating a river rise quantitatively. A rain-gauge collects the rain over an area of only 50 sq. inches, which is but a small sample, and is not accurately characteristic of what occurs in the way of rainfall over a broad area. Moreover, the conditions affecting run-off are too complicated to be readily allowed for. To estimate river rise from rainfall it is necessary to consider the distribution of rain in time and space over a drainage area. By dividing a drainage area on a map into a number of parts over which the time of water travel to a gauge station by the river is nearly the same, and by subdividing these parts into a number of other parts, 1,000 sq. miles or so in extent, over each of which the rain may be taken to be nearly uniform in depth and equal to the mean of the depth as shown by all the observations of rainfall within it, and by taking into account the average run-off, an approximate estimate can be made of the quantity of water that reaches a place on the river simultaneously from the various parts of the drainage area and from the rainfalls on different days. Comparing these amounts with the rises that have occurred in various instances, some idea can be formed of the relation of the two. This method of estimating a river rise is, however, not comparable in accuracy or ease of application with the method by comparison of river-stages, and is only resorted to where up-river gauge records are not available for prediction.

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Thomas Russell.

Floor [M. Eng. *floor*, *flor* < O. Eng. *flōr*: M. H. Germ. *flur* > Mod. Germ. *Flur*, floor, field, plain < Teuton. *flōrus* < Indo-Eur. *plārus*, deriv. of *plā-*, flat; cf. Gr. πλατύς: Lat. *plānus*, whence Eng. *plain*]: the lower surface of a room; the upper surface of the horizontal structure which separates one stage or story of a building from another, and whose under surface forms the *ceiling* of the story beneath; hence also the structure itself. In naval architecture the various floors are called *decks*. The construction of floors over wide spaces, and in structures where they are subjected to excessive strains of weight or vibration, presents problems of considerable difficulty which have engaged the skill and ingenuity of builders in all ages.

Wooden Floors.—The simplest form of floor is that in which beams called *joists*, stretching from wall to wall at short intervals, carry a *flooring* or covering of boards or planks nailed to them. In ancient and mediæval work the joists were usually heavy square timbers, widely spaced, and carrying a flooring of broad planks. Modern builders, recognizing that the transverse strength of a beam is as the square of the depth, employ deep and narrow joists, or stout planks set on edge, and concealed from view below by a ceiling of wood or plaster. To secure greater stiffness and freedom from vibration cross-bracing or bridging is resorted to, by means of which any strain upon one joist is distributed over several. When the span is too great for single joists, intermediate *girders*, carried on piers or columns, support the meeting-ends of adjacent rows of joists; or heavy beams or trusses span the area, and carry joists laid parallel to the walls. When it is desired to bring the tops of the joists flush with the top of the beam or girder, they are mortised into the latter, or hung to it by iron "hangers" or "stirrups." In frame buildings the joists are carried by the sills, girts, and wall-plates of the frame, and by intermediate girders, trusses, or partitions. Where openings exist for stairs, hearths, or chimneys, the joists abutting against the opening, called "tail-beams," are mortised or hung to transverse pieces called "headers," which in turn are framed to girders or double joists called "trimmers" on either side the opening. Single floorings are nailed directly to the joists, and in all but the cheapest work are composed of narrow boards, tongued and grooved to each other; the large number of narrow boards reducing the possible shrinkage of the flooring at each joint to a minimum. Better floorings are composed of an under-flooring next the joists, and an upper flooring of superior quality "blind-nailed" to it. Ceilings are made upon *furring-strips* nailed across the joists underneath, for the purpose of securing a perfectly even horizontal bearing for the laths or woodwork of the ceiling. When floors are to be *deadened* (or "deafened"), an intermediate surface of boards or of lath and plaster is formed between the joists at about half their depth, and sometimes leveled up to the top of the joists with "mineral wool" or simply with shavings, plaster, or other non-conductor of sound.

In the "slow-burning system" of mill-construction recommended by the Boston Manufacturers' Mutual Insurance Company, and widely adopted in New England, the floor is composed of 3-inch or 4-inch planks of Southern pine or oak, carried by heavy beams 8 or 10 feet apart, without cross-bracing or ceilings. The flooring-planks are grooved on both edges and joined by splines of hard wood. An upper flooring of $\frac{7}{8}$-inch stuff is often added.

Fire-proof Floors.—For description of floors with iron beams and brick arches or other filling, see article FIRE-PROOF BUILDING. Sometimes wooden joists are used, filled in between with slabs of fire-proof material, and protected on the under side by plastering applied to wire-lathing; but such floors do not possess the highest fire-resisting qualities.

Floors on Vaulting.—The Romans and Byzantines were masters in the art of building floors upon vaults of brick, stone, or concrete, an art which the mediæval builders carried to even higher perfection. In some parts of Italy and Hungary vaulting is still employed for this purpose, even in ordinary dwellings. But this method of construction is too costly, too heavy, and too wasteful of space to be often used in these days of steel beams. The so-called "Guastavino" system in large measure avoids these objections by the use of very thin vaults of hard tiles laid flat in cement, edge to edge, in two or three layers breaking joints, and with but little "rise" or curvature to the vault. The weight these thin elastic vaults will support is extraordinary. They are leveled on top with concrete to receive wooden or tile floorings.

Stone floors are rarely used, because of the great weight and relatively low transverse strength of slabs and beams of stone. Though frequent in ancient and mediæval buildings, their place is taken in modern work by the various kinds of fire-proof construction already referred to.

Floorings.—The most common materials used for finishing the upper surface of floors are wood, tile, flag-stones, mosaic, and concrete, or asphalt. Common floorings are of pine or spruce, laid as already described. Finer floorings are made with narrow strips of hard wood tongued and grooved, or splined, blind-nailed to the under-flooring, planed to a perfect level, and oiled, varnished, or waxed. Floorings of wood mosaic and parquetry are made of small pieces of hard wood of different colors, fitted together in decorative patterns and nailed to the under flooring. Tiled floors and floorings of marble mosaic require a firm and unyielding structure to carry them. The tiles, or the fragments of stone and marble composing the mosaic, are bedded in strong cement spread over a layer of concrete. The mosaic is then rubbed to an even surface and polished. Flagstones of marble or coarser material are laid in the same way. In France and in some other parts of Europe the floors of ordinary houses are not uncommonly laid with small hexagonal tiles of fine hard brick, which are varnished from time to time. Cement and asphalt are used for flooring basements, cellars, stables, and other places requiring a hard surface absolutely impervious to moisture. Such floorings are made by spreading a layer of pure cement, or of cement and sand mixed, or of asphalt, over a well-hardened bed of concrete of crushed stone, sand, and cement.

The Greeks, and after them the Romans, adorned their temples and public buildings, and even their private dwellings, with floors of marble and of mosaic of great beauty of design and workmanship. (See MOSAIC.) The floors of the early Christian basilicas of the East were often finished in a combination of *opus Alexandrinum* or mosaic of minute triangles of bright-colored material, and *opus sectile*, or patterns in which each area of color was of a single piece of marble cut to the required shape. The Byzantine architects also wrought splendid floorings of the same kind for their churches, as in the church (now mosque) of Agia Sophia in Constantinople, and the Italians have for centuries excelled in this sort of work. Floorings of fine material and artistic design are far more common in Europe than in the U. S., where, however, they are now more frequently used than formerly.

Weight on Floors.—This varies greatly for different classes of buildings. In calculating the strength of floor-beams it is customary to allow for a weight of 80 lb. per sq. foot in dwellings, schools, and hay-lofts; 120 lb. in churches, theaters, and places of public assembly. But the experiments of B. B. Stoney, in England, have shown that this is sometimes largely exceeded in "crushes" such as occur in the vestibules of theaters, etc. For granaries, 100 lb. per sq. foot may be allowed; for warehouses, 250 lb.; for factories, 100 to 400 lb. To these weights should always be added that of the floor itself, varying from 18 lb. per sq. foot in ordinary wooden floors with plaster ceilings under them to 35–60 lb. in fire-proof floors with brick arches.

Formulas for Beams.—The requisite size and strength of iron and steel beams for floors are calculated by means of tables furnished by the manufacturers of the various patterns used. For wooden beams, however, the calculations may be made by the architect or builder by the use of the formulas

$$d = \sqrt{\frac{scl^2(W+w)}{2Ab}} \qquad (1)$$

$$c = \frac{2Abd^2}{sl^2(W+w)}, \qquad (2)$$

in which $W =$ assumed load per square foot on floor; $w =$ weight of floor itself per square foot; $l =$ length of beam in feet; $b =$ breadth of beam in inches; $d =$ depth of beam in inches; $c =$ distance apart on centers in feet; $s =$ factor of safety assumed (usually from 3 to 5); and A is a constant determined by experiment, viz., 240 for white pine, 270 for spruce, 315 for oak, and 375 for hard pine. Formula (1) gives the depth of beam required for a given span, thickness, and spacing of the joists; and formula (2) the proper spacing on centers for beams of a given dimension.

When, however, it is desired to calculate the load which a given beam will carry without exceeding a deflection of $\frac{1}{40}$th of an inch per foot of space, the following formula should be used:

$$L = \frac{8bd^3e}{5l^2},$$

in which $L =$ safe load required; b, d, and l are the same as in (1) and (2), and e is a constant, viz.: 62 for white pine, 72 for white oak, 75 for spruce, 103 for yellow pine.

Special Floors.—Special kinds of floors and flooring are required by certain industries and for particular purposes. Thus theaters, amphitheaters, lecture-halls, and sometimes churches, require inclined floors in order to bring the remoter spectators within sight and hearing of the speaker or performer on the stage or platform. Such floors are usually built upon stagings from a level floor forming the ceiling of the space or story below. Ship-builders make use of a vast draughting-floor of pine on which to plot the curves of the ship-frames; it serves as a drawing-board, on which the lines are erased by scraping or sandpapering when no longer required. Molding-floors in foundries are of sand, upon which the molds for casting are laid, or in which they are formed. Floors of piazzas and balconies are made of slats set slightly apart to allow rain-water to drain away, or are covered with duck or canvas, tightly stretched and painted, to exclude the water; in either case the floor should be inclined with a pitch outward of an inch in every 6 to 10 feet, and the boards be laid lengthwise across this slope. It is hardly necessary to enumerate other varieties of floors, of which the list might be indefinitely prolonged. Consult article cited, and MILL-CONSTRUCTION; also Hatfield's *American House-carpenter*, Kidder's *Architect's and Builder's Pocket-book*, and general text-books on construction.

A. D. F. HAMLIN.

Floor-cloth, or **Oil-cloth**: oil-painted canvas, both sides of which are painted with one or more coats, one side being subsequently printed with designs in colors. Floor-cloths are usually printed by hand by the old method of block-printing. The compounds linoleum, kamptulicon, and the like are substitutes for common floor-cloths, and are made by patented processes. India-rubber is an ingredient of some of these, and they are often stiller under foot and warmer, but sometimes less durable than good oil-cloth.

Floquet, flō′kā′, CHARLES THOMAS: politician; b. Oct. 5, 1828, at St.-Jean-de-Luz, France; studied at the Collège St. Louis; called to the bar 1851; 1867 offended the Czar Alexander II., when a guest of Emperor Napoleon III., by crying, "Vive la Pologne"; consequently was under the Russian ban until 1888; 1871 radical member of the National Assembly; 1876 member of the Chamber of Deputies; 1883 Prefect of the Seine; 1885–88–89 president of the Chamber; 1888–89 Prime Minister; in July, 1888, fought his famous duel with Gen. Boulanger, severely wounding Boulanger in the throat. In 1892–93 he was implicated in the Panama scandals, to the injury of his political standing. D. Jan. 18, 1896.

C. H. THURBER.

Flo′ra [= Lat. *Flora*, goddess of flowers, deriv. of *flos*, *floris*, flower]: (in mythology) a deity early worshiped among the Romans as the goddess of flowers and of spring, and identified with the Grecian Chloris. A temple was vowed to her by Tatius, and a flamen appointed to serve at her altar. Her temple was situated near the Circus Maximus, and an annual festival was held in her honor between Apr. 28 and May 3, when every licentious extravagance was indulged in by the populace. She was represented bearing the cornucopia filled with flowers.

A late tradition says that Flora was a wealthy courtesan who bequeathed her riches to the city on condition that she should be worshiped; but stories of that kind generally originated with people who liked to bring the Roman religion into contempt, either atheist philosophers or Christian Fathers. Lactantius seems to have been the first who knew the story of Flora. The Romans themselves identified her with the Greek Chloris—not the wife of Neleus, but the daughter of Niobe. Her true name was Melibœa, and she and her brother Amyclas were the only ones of Niobe's children who escaped Apollo's revenge, after which her name was changed into Chloris.

Flora: in botany, the aggregate vegetation of a country or region; thus when the "flora of the Black Hills" is spoken of, reference is made to the natural vegetation of that portion of the country, just as the animal life of a country is referred to when its fauna is spoken of. A catalogue or description of the flora of any country is often called simply the "flora" of the country, as Gray's *Synoptical Flora of North America* (1878–84); Hooker's *Student's Flora of the British Islands* (1884); Gremli's *Flora of Switzerland* (1889).

CHARLES E. BESSEY.

Flora: city and railway junction; Clay co., Ill. (for location of county, see map of Illinois, ref. 9–F); 94 miles E. of St. Louis, Mo. There are 40,000 acres of apple-orchards in the county, and Flora is a great fruit-market. Immense coal-beds underlie the soil. The climate is fine. Pop. (1880) 1,494; (1890) 1,695; (1900) 2,311.

EDITOR OF "DEMOCRAT."

Floréal, flō′rā′ăăl′ (the flowery): the eighth month in the republican calendar of France, which from Nov. 24, 1793, to Sept. 9, 1805, was used in place of the Gregorian. Floréal began Apr. 19–22, and ended May 18–21.

Flore, Order of [so called from *Floris* (a place near Cosenza), the seat of the first abbey]: a branch of the Cistercians, including convents of nuns as well as those of monks. The order was founded by Joachim of Floris in 1189, and, being suspected of maintaining the heresies of its founder, it never flourished. In 1505 most of its convents joined the Cistercians and other orders.

Flor′ence (Ital. *Firenze*): province of Italy; area, 2,144 sq. miles. It is one of the most fertile provinces of the country; wheat, wine, and silk are extensively produced. Pop. (1891) 813,031.

Florence [from Lat. *Florentia*, deriv. of *florens*, *floren′tis*, blooming, prosperous, pres. partic. of *flore′re*, bloom]: a city of Italy; situated 195 miles N. W. of Rome, in the beautiful valley of the Arno, mostly on the northern bank (see map of Italy, ref. 4–D). Pop. of commune (1895) 204,000. It is one of the most beautiful and interesting cities of Italy, an archbishop's see, and a principal seat of art and science. The industry of the city was formerly more flourishing, and comprised extensive manufactures of silk, velvet, and woolen; it is now remarkable only in works of art, mosaic, and jewelry.

The inner part of the city was formerly surrounded by a wall, but gardens, palaces, and monasteries cover the neighboring hills. The city has been made brighter by the construction of new and wider streets, and new and beautiful palaces are added to the great number of old and celebrated monuments. The Arno, dammed up to 100 paces breadth, is provided with quays, called *Lungarni*, and six bridges connect the different parts of the city with each other. These bridges and quays, with the Via della Scala and Via Maggio, form the liveliest parts of the city, and more than twenty public squares, surrounded by beautiful buildings, adorn it. Among these public squares the most remarkable is the Piazza del Granduca, now called the Piazza della Signoria, which is very rich in works of art. It contains the great fountain, adorned with twelve bronze statues by Giovanni of Bologna: the beautiful equestrian statue in bronze of Cosmo I., by the same artist; the colossal Neptune and the Tritons of marble by Ammanato; and the statue of Hercules by Bandinelli. The old palaces stand generally among common houses in narrow streets, and their heavy and massive architecture gives them a gloomy character. In the Middle Ages they served as strongholds. They were built of large blocks of freestone with battlements, and often with towers, but without any exterior embellishments. They are now, moreover, blackened by age. In the interior they contain courtyards, with arcades from which stairs lead into the halls. One of the most interesting palaces is the Palazzo Vecchio, or Palazzo della Signoria, at one time the seat of the Florentine magistrature, and from 1865 to 1871 of the Italian Parliament. The Palazzo Pitti, built by Brunelleschi, and the residence of Victor Emmanuel while in Florence, is one of the most magnificent palaces in existence. It contains the Galleria Pitti, the finest collection of pictures in the world, and the Pitti and Uffizi collections are connected by a long gallery, passing over the Ponte Vecchio.

Remarkable among the ecclesiastical buildings is the cathedral, 555 feet long, 340 feet broad. Arnolfo da Colle commenced the building, and continued it until 1310; Giotto succeeded him, and Brunelleschi finished it in 1436. The marble covering of the cathedral is rich and varied; especially is that of the campanile delicate and fine in color. The construction of the vaults of the baptistery of San Giovanni is very interesting, and the three doors of bronze, especially that of the eastern gate by Ghiberti, are widely known. The Church of Santa Croce, commenced in 1294 by Arnolfo di Cambio, 371 feet long and 113 feet wide, has eleven chapels, and contains the tombs of Michael Angelo, Alfieri, and Machiavelli, and a monument of Dante. A most interesting building is the Loggia dei Lanzi, a hall commenced in 1376, and finished by Benci di Cione and Simone di Francesco Falenti after a plan by Orcagna. It contains masterpieces of marble and bronze—the Vestals, the Centaur, Ajax with the corpse of Patroclus. Between the Loggia dei Lanzi and the Palazzo Vecchio is situated the Palazzo degli Uffizi, containing the world-famous collections of statuary in marble and bronze (the group of Niobe and the Medicean Venus), of cameos, pictures (*Venus*, by Titian, the *Holy Family*, by Michael Angelo), and crayons.

History.—Florence, originally a Roman colony in Etruria, was a flourishing city at the time of Christ. Under Totila it was destroyed, but it was rebuilt under Charlemagne. The German emperors, especially Otho the Great, favored the city in many ways; and as its position was of much consequence in military respects, many knights settled here, and the nobles early gained the ascendency. Parties fought in Florence as in other cities; nevertheless, in the ninth and tenth centuries it became a center of civilization, and increased its political importance by conquering the neighboring cities and towns. In the beginning of the twelfth century it threw off the authority of the German emperors and established a republic, and in 1198 it headed the union of the Tuscan cities against Philip of Suabia. In the beginning of the thirteenth century Florence was governed by a podestà, who, however, held the supreme authority only in matters of justice; the administration and the political power depended on six consuls and a municipal council of 100 citizens. The republic had an oligarchical character, but although it was convulsed by the civil wars between the Guelphs and the Ghibellines the city still increased in power. In 1078 the enlargement of the city made a second wall necessary, and between 1284 and 1327 the third wall, the present one, was built. In 1222 Florence conquered Pisa, and gained great commercial advantages; in 1332 it conquered Pistoja, in 1333 Massa, and soon it ruled over the whole of Tuscany. The authority of the nobility began to decrease; the citizens acquired ascendency, and in 1378 the democracy gained a decided victory, Salvestro de Medici, a plain citizen, becoming gonfaloniere. It was, however, Giovanni de Medici, the banker of the pope and a man of immense wealth, who founded the house. At his death in 1428 he left two sons, Cosimo and Lorenzo, from the latter of whom the dukes of the sixteenth century descended. Cosimo acquired great fame during the Council of Florence in 1439, and his grandson, Lorenzo the Magnificent, added still more to the splendor of the house. In 1478 the conspiracy of the Pazzi against the Medici failed, and in 1492 Pietro succeeded his father Lorenzo as gonfaloniere. He was expelled, however, and Savonarola established a kind of theocracy, but was burnt as a heretic in 1498. By the victory of Alessandro of Medici (Aug. 12, 1530) the republic was finally overthrown, and Alessandro was declared Duke of Florence, July 29, 1531. He was killed in 1539, but his son succeeded as grand duke. After the death of the last Medicean grand duke the government of Tuscany, of which Florence was the capital, fell to Francis, Duke of Lorraine, afterward Emperor of Germany. His descendants were expelled by the French in 1799. In 1801 Tuscany became a part of the kingdom of Etruria under Louis of Parma. In 1808 it came under the sway of France. In 1814 the Grand Duke Ferdinand III. once more took possession of the country, but in 1859 his son, Ferdinand IV., had to abdicate, and on May 22, 1860, Tuscany was incorporated into the kingdom of Italy, of which Florence was the capital until 1871, when the seat of government was transferred to Rome.

Florence: city and railway center; capital of Lauderdale co., Ala. (for location of county, see map of Alabama, ref. 1–B); situated on the north bank of Tennessee river, at the head of deep-water navigation and at the foot of Muscle Shoals Canal. It has the Southern Female University, Synodical Female College, Paxton's Military and Classical Academy, State Normal College, fine city schools, sawmills, and extensive manufactures of cotton and iron. Pop. (1880) 1,359; (1890) 6,012; (1900) 6,478. EDITOR OF "HERALD."

Florence: city; Marion co., Kan. (for location of county, see map of Kansas, ref. 6–H); on the Atchison, Topeka and Santa Fé Railroad; at the junction of the Cottonwood river and Doyle creek. It is situated in a wheat-producing district, and has quarries of building-stone. Pop. (1880) 954; (1890) 1,229; (1900) 1,178.

Florence: town and railway junction; capital of Florence co., S. C. (for location of county, see map of South Carolina, ref. 5–F); 102 miles N. of Charleston. It has railway shops, a mill, machine-shops, and a large trade in cotton. Pop. (1880) 1,914; (1890) 3,395; (1900) 4,647.

Florence, WILLIAM JERMYN (real name BERNARD CONLIN): actor; b. in Albany, N. Y., July 26, 1831. He joined a dramatic association in New York city 1847; made his first appearance in Richmond, Va., Dec. 6, 1849, as Peter in *The Stranger*. He played in Providence, R. I., Macduff to Booth's Macbeth. At Brougham's Lyceum in New York he afterward appeared in Irish characters. He married in 1853 Mrs. Malvina Littell, a dancer attached to Wallack's theater, and subsequently the two appeared at the National theater, New York, as the Irish Boy and the Yankee Girl. In 1856 Florence and his wife went to England, traveled through the British provinces, and were well received. On returning to the U. S. they acted regularly every season in the principal towns and cities of the Union. In 1887 Mrs. Florence practically retired from the stage and Florence joined Joseph Jefferson, playing with him in some of the old comedies. His best-known parts are Capt. Cuttle in *Dombey and Son*, Bardwell Slote in *The Mighty Dollar*, and Robert Brierly in *The Ticket-of-leave Man*. D. in Philadelphia, Pa., Nov. 20, 1891. B. B. VALLENTINE.

Florence, Council of, 1439–42 A. D.: the continuation of the Council of Basel, the seventeenth of the twenty œcumenical councils acknowledged by the Church of Rome. The Council of Basel was opened July 23, 1431. Called in the interest of reform, the attendance at first was small, the pope, Eugenius IV., being hostile. In 1434 a reconciliation was brought about, and the pope took the direction of affairs into his own hands. On Jan. 8, 1438, the council was transferred to Ferrara, and in Feb., 1439, to Florence, where its sessions continued at intervals until 1442. But its interest culminated in the summer of 1439, when the reunion of the Greek and Latin Churches was thought to have been accomplished. More than 500 Greeks, including the Greek emperor and the Patriarch of Constantinople, were in attendance, having joined the council at Ferrara. Four points were under discussion: 1, the Filioque of the Latin Creed; (2) the use of unleavened bread in the Eucharist; (3) purgatory; (4) the papal supremacy. The first three points were settled by compromise; the fourth by the submission of the Greeks. But the impulse of this settlement was imperial, the Greeks desiring Occidental assistance in beating back the Turks. The "reconciliation" had no root in the hearts of the people, and in 1443 the patriarchs of Alexandria, Antioch, and Jerusalem united in denouncing the Council of Florence. Meanwhile the remnant of the council summoned by Eugenius IV. continued to sit at Basel; in 1440 it elected an antipope (Felix V.), who resigned in 1449; removed to Lausanne, July 24, 1448, and dissolved May 25, 1449. See Mansi's *Councils* (vol. xxix.); Harduin's *Councils* (vols. viii. and ix.); and Hefele's *Conciliengeschichte* (vol. vii., part 2, 1874). Revised by S. M. JACKSON.

Florence, University of: See the Appendix.

Florencia, FRANCISCO, de: Jesuit author; b. in Florida (probably in St. Augustine), 1620. He studied in the College of San Ildefonso, Mexico; took the Jesuit habit in 1643; acquired considerable fame as a teacher and pulpit orator; was procurator of his province at Madrid and Rome 1688, and subsequently procurator-general for the Indies at Seville. His *Historia de la provincia de la Compañía de Jesus de Nueva España* was the first Jesuit history of Mexico (1st vol. only, Mexico, 1694). He also published several biographical works relating to the Jesuits, and numerous theological treatises. D. in Mexico, 1695.

Florentine Academy (in Ital. *Accademia Fiorentina*): a learned association of Florence, founded in 1540. It is famous as successor of the Accademia della Crusca. See DELLA CRUSCA.

Floren'tius: the name of several men eminent in history and in letters. Among them are FLORENCE (Florentius) OF WORCESTER, a learned monk who died in 1118; author of a Latin chronicle, the first written in England after the Norman Conquest; English translation edited by Thomas Forester, London, 1854 (in Bohn's Library).—FLORENTIUS RADENIUS; b. at Leerdam in the Low Countries in 1350; was educated at Prague; succeeded Gerhard Groot as director of the Brethren of the Common Life. D. 1400. See his *Life* by Thomas à Kempis.—Another FLORENTIUS (*François Florent*) was a Burgundian jurist, who died Oct. 29, 1650; author of *Dissertations* on the canon law (1632), etc.

Flo'res: a central department of Uruguay; created in 1885 from the northern part of San José; bounded N. and N. E. by Durazno, S. by San José, and W. by Soriano. Area, 1,745 sq. miles. The river Yi borders the department on the north. The land is generally rolling and open, suited for pasturage, and grazing is the principal industry. Wheat and maize are cultivated to some extent. Pop. (1890) about 20,000. Capital, Trinidad, 123 miles N. E. of Montevideo, with about 2,500 inhabitants. HERBERT H. SMITH.

Flores: the westernmost island of the Azores; in the Atlantic Ocean; in lat. 39° 25′ N. and lon. 31° 12′ W. Area, 54 sq. miles. Its name was given it by the Portuguese in allusion to the flowers with which it is covered. Pop. 9,000. Chief town, Santa Cruz.

Flores: an island of the Malay Archipelago, and the largest of the chain that extends from Java to Timor. Its length is 230 miles, its breadth about 35 miles. Area, 8,900 sq. miles. It is hilly, with some lofty volcanic peaks on its south side. It exports sandal-wood, beeswax, and horses. The aborigines are Papuans, but the Malays outnumber them by far. Pop. estimated at 250,000.

Flores, ANTONIO: Ecuadorian statesman; son of Gen. Juan José Flores; b. in Quito, 1833. He studied in Paris, and subsequently graduated in law at Lima. He early took part both in civil and military affairs, and has occupied important diplomatic positions, including the ministry to Washington 1861 and again 1868–69; in 1885 he signed the treaty with Spain in Madrid. He succeeded Caamano as president of Ecuador, June 30, 1888, serving until 1892. His term was commendably quiet and prosperous. HERBERT H. SMITH.

Flores, JUAN JOSÉ: Spanish-American general and statesman; b. at Puerto Cabello, Venezuela, July 19, 1800. In his youth he was taken prisoner by the Spaniards, and on his escape in 1815 joined Bolivar; rapidly rose in rank, and took part in the principal events of the war for independence in Venezuela and New Granada. In 1823 he was colonel, and civil and military chief of Pasto; the Spaniards drove him back to Popayan, but he regained the ground as second in command under Salom, and subsequently commanded in the final defeat of the Spaniards in that region (1824). In 1825 he was made commandant-general of Ecuador, and in 1828 commander-in-chief of the Ecuadorian army, defending the country against the Peruvians 1828–29. Bolivar made him civil and military chief of the south in the latter year, and when, in 1830, Ecuador became independent Gen. Flores was elected president. During his term he put down several revolts, including one headed by Rocafuerte, 1833–34; Rocafuerte was captured, but Flores pardoned him, gave him important civil and military posts, and in 1835 supported him for the presidency, to which he was elected. Under Rocafuerte Flores was nominally commander-in-chief of the army, but virtually governed the country; in 1837 he was elected to the senate, and in 1839 was again elected president; by re-election in 1843 he retained the office until 1845. In 1840 and 1841 he interposed in the affairs of New Granada, marching in person against the revolutionists in Pasto and defeating them. In 1845 a revolution broke out in Ecuador, and, though Flores twice defeated the insurgents, he found it prudent to resign; he left the country, traveled extensively in Europe and America, and only returned in 1863 to take part in the movement by which Franco was overthrown; he then accepted the post of vice-president. D. in Quito, 1864. HERBERT H. SMITH.

Flores, VENANCIO: Uruguayan general and politician; b. in 1809. He was the son of a wealthy landed proprietor, and for many years lived on the pampas, where he gained great influence with the gauchos. He supported the *Colorados* in their revolt against Oribe 1853; on Oribe's overthrow he became one of the governing triumvirate, and in Mar., 1854, was elected president for two years. Oribe headed a counter revolt in Sept., 1855, and at length both claimants to the presidency agreed to resign; Pereira was then elected president, and soon after Flores retired to Buenos Ayres, where he served under Gen. Mitre, and took a prominent part in the battle of Pavon Sept. 17, 1861. In Apr., 1863, he secretly returned to Uruguay, and initiated a revolt of the *Colorados* against President Berro. A desultory war was carried on against Berro and his successor, Aguirre; Brazil, having declared war against the government of the latter, joined forces with Flores; Aguirre was defeated, 1865, and forced to resign. Flores was made provisional governor, and in 1866 was elected president. He at once signed with Brazil and the Argentine Republic the treaty of alliance against Paraguay, called the Triple Alliance, taking part in the campaigns of 1865 and 1866. He was assassinated at Montevideo during a political disturbance, Feb. 19, 1868. HERBERT H. SMITH.

Flo'rian, SAINT: patron saint of Poland; was a Roman soldier; b. in Noricum of Christian parentage, and drowned in the river Enns in Austria during the Diocletian persecution, on account of his voluntary confession of the Christian faith. He was buried where now stands the magnificent Augustinian abbey of St. Florian, 3 miles S. W. of Enns, but his relics were transferred to Rome, whence in 1183 they were taken to Cracow. In legendary lore St. Florian is honored as the extinguisher of conflagrations. He is commemorated on May 4.

Florian, flō'ri-aăn', JEAN PIERRE CLARIS, de: b. at the Château de Florian, in Gard, France, Mar. 6, 1755; entered the service of the Duc de Penthièvre; was patronized by Voltaire, and attained fame as a writer of fables, romances, comedies, and pastoral poems; was imprisoned in Paris by the republicans, and d. at Sceaux, Sept. 13, 1794. Some of his plays still keep the stage, but his romances *Galatée* and *Estelle*, his *Fables*, and his translation of *Don Quixote* are his best works.

Floriculture [from Mod. Lat. *floricultu'ra*; Lat. *flos*, *floris*, flower + *cultu'ra*, cultivation, deriv. of *co'lere*, cultivate]: the cultivation of ornamental plants for their individual uses. The cultivation of ornamental plants for their uses in the landscape is a part of LANDSCAPE-GARDENING (*q. v.*), or more properly of landscape-horticulture. Floriculture is now an important industry in the U. S., and no rural pursuit offers greater attractions, whether in the business itself or in its pecuniary rewards. The business readily divides itself into two features, growing plants for sale, which really belongs to the nursery trade (see NURSERY), and growing cut flowers and plants for decoration. The eleventh census made an investigation of the floricultural interests of the U. S. The business is found to be in a thriving condition, as evidenced by the fact that the number of establishments is rapidly increasing. In 1800 there was but one commercial florist in the U. S. Between 1810 and 1820 3 establishments started: 8 more were started in the next decade, 25 in the next, 45 between 1840 and 1850, 96 in the next, 313 in the next, 998 between 1870 and 1880, and 1,797 between 1880 and 1890. In 1890 there were 4,659 commercial establishments, using 38,823,247 sq. feet of glass and heated with apparatus valued at $38,355,722.43. The tools were valued at $1,587,693.93. New Jersey has the largest floricultural business of any State in proportion to its size. There is not one establishment, so far as learned, in Idaho, Nevada, and Indian Territory. Three hundred and twelve of these establishments are owned and conducted by women, and 1,958 women are engaged in the business in the U. S. The total value of the floricultural product for one year was $26,211,805.77, of which $14,175,328.01 was for cut flowers and the remainder for plants. Of the plants sold, 49,056,253 were rose-bushes and 38,380,872 were hardy plants and shrubs, while the total number of all plants sold was 240,272,417. It required 18,805 people to grow these plants and cut flowers, at an aggregate wage of $8,483,657. All this business required an outlay of $1,161,168.31 for advertising and the issuing of 21,055,694 catalogues, and the estimated freight and express bills on outgoing shipments amounted to $1,086,904.60.

The census report for 1890 states that "of the plants sold the demand in the Northern and Eastern U. S. is greatest for geraniums, coleus, roses, pansies, verbenas, heliotrope, carnations, chrysanthemums, palms, ferns, and fuchsias, nearly in the order named. In the Southern U. S. the demand is for roses, chrysanthemums, geraniums, coleus, palms, and ferns; while California shows the demand to be largest for roses, carnations, chrysanthemums, geraniums, palms, and pansies. For cut flowers roses lead, followed closely by carnations."

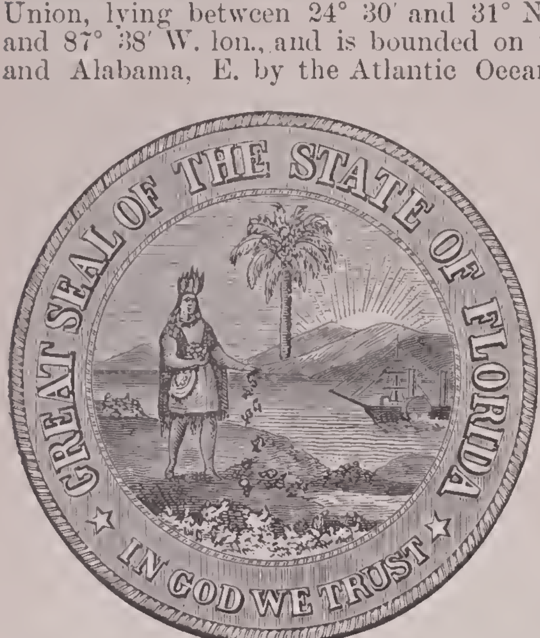
Besides the capital invested in commercial floriculture there is a very large interest in amateur flower-growing, and it is probably safe to say that no other avocation attracts so many people. Amateur gardening is most conspicuous, as a rule, in the Eastern States, but almost every village in the land affords some example of devotion to flowers for the pleasure which they afford. The passion for flowers is one of the refinements which comes from a love of home and rural life. L. H. BAILEY.

Florida: a central department of Uruguay; bounded N. by Durazno, E. by Minas and Treintaitres, S. by Canelones, and W. by San José; area, 4,280 sq. miles; pop. (1890) 29,516. The mountains or hills of the Cuchilla Grande form the eastern border; the general surface is rolling, with but few high hills, and there are extensive grassy plains bordering the river Yi, which forms the northern boundary. Cattle-raising is the principal occupation; the number of horned cattle alone is estimated at 1,500,000, and vast flocks of sheep are raised. Owing to the rich pastures, many other departments send their cattle here during the winter. Florida, the capital, on the river Santa Lucia Chico, has 4,000 inhabitants. Sarandi Grande, on the Central Uruguayan Railway, is a new town of considerable commercial importance.

HERBERT H. SMITH.

Florida: one of the U. S. of North America (South Atlantic group) and the second largest of the group E. of the Mississippi river. In shape it is somewhat like an inverted L.

Situation and Area.—It is the southernmost State of the Union, lying between 24° 30′ and 31° N. lat. and 79° 48′ and 87° 38′ W. lon., and is bounded on the N. by Georgia and Alabama, E. by the Atlantic Ocean, S. by the Gulf of Mexico and Straits of Florida, and W. by the Gulf of Mexico and Alabama, the Perdido river forming the extreme western boundary. From the northern boundary to the southernmost outlying island the distance is 450 miles. From the Atlantic Ocean to the Perdido river the distance is 400 miles, and from the northwestern corner of the State to Key Largo it is nearly 600 miles, the line running diagonally across the Gulf of Mexico. The peninsula proper is about 375 miles long, and has an average width of 90 miles. The actual area is 58,680 sq. miles, or 37,555,200 acres. Lakes, rivers, bays, and estuaries cover nearly 3,000,000 acres, an area often quadrupled in extent during a rainy season.



Seal of Florida.

Name.—The name is abbreviated from the Spanish *Pasqua Florida* (Easter, or the Feast of Flowers), so called from its discovery by Ponce de Leon on Easter Day, 1513. "The Everglade State" is perhaps the most generally accepted nickname.

Topography.—The general impression received by the traveler is that Florida is mainly a monotonous level, but this is strictly true only as regards wide areas along the coast, the land rising only a few feet above the sea-level. These "flatlands" are irregularly distributed in open grass-grown savannas, pine forests, cypress swamps, and "cabbage hammocks," the latter being the local name for extensive native growths of the cabbage-palm. The general level rises toward the interior until, almost insensibly, the low pines give way to high pines, and these again to hills of considerable altitude. The highest part of the peninsula proper is along the central ridge, where, according to the railroad surveys, an elevation of nearly 300 feet is reached; the rise, however, is so gradual that only the engineer's level can define it. In Western Florida the land is decidedly hilly, excepting along the coast, and is very heavily wooded. Topographically, it belongs to Georgia and Alabama. The southern part of the peninsula proper is occupied by a vast tract known as the Everglades (probably an adaptation of the English word "glades" with the prefix ever to indicate its extent).

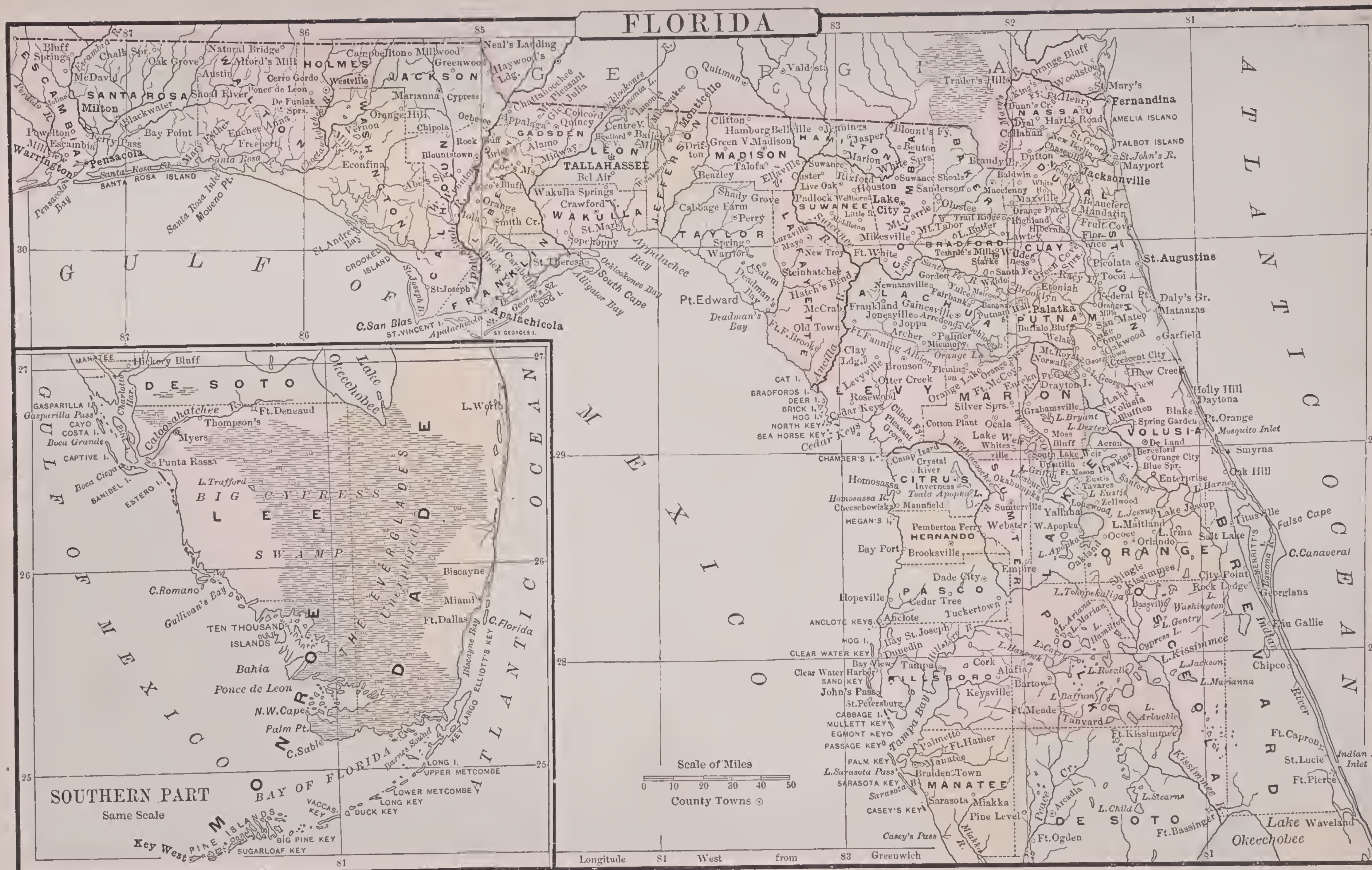
In general terms this southern portion of the peninsula has been formed by successive dikes of coral built in bygone ages and inclosing most of the space that now forms "subtropical Florida." The upper part of this is occupied by the shallow waters of Lake Okeechobee, which merges into the Everglades proper to the S. and E., and is destined eventually to be filled up and become a part of the grass-grown tract now the abode of the remnant of the once powerful Seminole Indians, whose name for it is *Pa-ha-yo-kee*—much grass in water. They are penetrated in all directions by tortuous open channels of water only a few feet in depth, and at short intervals over the whole tract are wooded islands possessing great fertility of soil and usually covered with a dense growth of sub-tropical vegetation. These islands no doubt were once surrounded by the sea, and stood in the same relation to the mainland as do the present Florida reefs and keys. The Everglades are separated from the Gulf of Mexico by wide tracts of cypress swamp. These forests extend toward the southern point of the peninsula, but are narrowed as they turn the cape and extend up along the Atlantic coast. The Everglades approach the ocean most nearly on the eastern coast at Biscayne Bay, where the distance across is barely 5 miles, the intervening elevation being an ancient dike of coralline rock, crossed at short intervals by streams of considerable volume, navigable for small boats and flowing out from the Everglades in strong currents of clear, sweet water. The Everglades, far from being a stagnant swamp as has been popularly supposed, are in reality a not unhealthful region.

At frequent intervals throughout the lowlands, particularly along the coast, are extensive swamps, some of which have never been explored, owing to the impenetrable character of the undergrowth and the impassable holes and sinks that break the surface. Prominent among these great swamps are the Big Cypress near the southern extremity of the peninsula, several of great extent farther to the north, as the Fen Holloway and Wakulla swamps; there is also an extensive swamp near the mouth of the Appalachicola river. The largest of the inland swamps is the Okefenoke, which extends far to the northward beyond the Georgia line.

Almost the entire shore of the mainland is separated and protected from the ocean by outlying sand-bars, which eventually become islands and peninsulas as vegetation covers them. The inner or sheltered sea-beaches consist for the most part of rather soft sand, not easy to walk upon, impracticable for vehicles, and often of the nature of quicksand. The outer beaches are often for scores of miles as hard and level as a macadamized road. Along the tidal rivers of sub-tropical Florida the mangrove is ever encroaching on the sea, and often absolutely prohibits passage along the water-side. Elsewhere the underlying coralline or limestone rock crops up, forming a natural sea wall; this is notably the case at intervals along the Indian river, Lake Worth, and Biscayne Bay on the Atlantic coast, and at the mouths of nearly all the principal rivers of the Gulf coast. Where these rivers break through the coral dikes extraordinary formations are found. In many instances natural bridges exist, and there are often deep rock cuttings of great beauty and interest to the geologist.

Springs, Streams, Lakes, etc.—Some of the most remarkable springs in the world exist in Florida. The most famous is Silver Spring near Ocala in Marion County, but there are many others that are only less celebrated because they are out of the line of travel. Among these is Blue Spring, also in Marion County, Wekiva Spring, in Orange County, and Wakulla Spring, near Tallahassee. The extraordinary clearness of the waters of these springs is as remarkable as their size. In several instances navigable streams burst full-grown from the earth. The volume of Silver Spring is over 300,000,000 gal. daily (D. G. Brinton's estimate). The clearness of the water is such and its refractive powers so great that it is almost impossible to believe that objects lying on the bottom at a depth of 30 or 40 feet are not actually magnified by the water. Along the coast are found countless springs of fresh and sulphuretted water. One of these of large volume bursts upward through the sea itself not far from St. Augustine, boiling so violently to the surface 2 miles from shore that the ocean rollers break against the column of fresh water as if it were a sunken reef. The total volume of water discharged by these multitudinous springs baffles computation, and where the supply comes from, with only a narrow peninsula for a watershed, is a perplexing problem.

The lakes are largely aggregations of smaller springs, sometimes being themselves the direct sources of rivers and sometimes members of lacustrine systems. There are several principal lake groups, one lying along the head waters of the St. John's river, including Lakes Munroe, George, Dexter, Crescent, and others. The Oklawaha river, a tributary of the St. John's, finds its source in a fine group of lakes including Apopka, Dora, Harris, Eustis, and Griffin. S. of these again is the Kissimmee group including the Tohopekaliga lakes, Kissimmee, and others. This group unites to form the great Kissimmee river flowing southward through vast tracts of swampy wilderness until it discharges into Lake Okeechobee, the largest body of open fresh water in Florida. This great lake is quite shallow, barely exceeding more than 12 or 15 feet in depth. Its area is about 1,250 sq. miles. It is for the most part surrounded by a wide belt of almost impenetrable "big saw-grass," so that it is only accessible by the natural waterways leading from the higher levels. Its main outlet is by the Caloosa river, which flows into the Gulf of Mexico at Charlotte harbor. The surface of the lake is only 20·24 feet above the sea-level, and its distance from the coast is sufficient to prohibit artificial drainage. In general the Florida lakes are shallow, save where chasms and fissures occur in the bed-rock, and these are often springs discharging enormous volumes of water. Of


FLORIDA
ATLANTIC OCEAN
GULF OF MEXICO
GEORGIA
Scale of Miles
0 10 20 30 40 50
County Towns
Longitude 84 West from 83 Greenwich
TALLAHASSEE
Pensacola
Jacksonville
Fernandina
St. Augustine
Apalachicola
Palatka
Key West
Lake Okeechobee
SOUTHERN PART
Same Scale
THE EVERGLADES (Unexplored)
BIG CYPRESS SWAMP
BAY OF FLORIDA
ESCAMBIA
SANTA ROSA
WALTON
HOLMES
JACKSON
WASHINGTON
CALHOUN
GADSDEN
LEON
WAKULLA
JEFFERSON
MADISON
TAYLOR
LAFAYETTE
SUWANEE
COLUMBIA
HAMILTON
BAKER
NASSAU
DUVAL
CLAY
BRADFORD
ALACHUA
PUTNAM
ST. JOHNS
LEVY
MARION
VOLUSIA
CITRUS
SUMTER
HERNANDO
LAKE
ORANGE
BREVARD
PASCO
HILLSBORO
POLK
OSCEOLA
MANATEE
DE SOTO
LEE
DADE
MONROE
FRANKLIN

smaller lakes named and unnamed there are hundreds, perhaps thousands, scattered everywhere among the "flatwoods" as well as among the hills. The water is generally pure and hard, with traces of magnesia and sulphur, and usually the bottoms are clean and sandy. Fish are found in almost all of them in great abundance. Many of the Florida lakes are subject to remarkable fluctuations, rising or falling at regular or irregular intervals, sometimes even running dry for longer or shorter periods. These phenomena are chargeable almost always to the freaks of subterranean rivers which from time to time change their channels. Lake Jackson suddenly ran dry about the time of the Charleston earthquake. After a few weeks, however, the water began returning to it, and it resumed its natural proportions. Similar phenomena on a smaller scale are of frequent occurrence wherever the underlying rock strata are liable to erosion, and this condition prevails over almost the entire State. Where the openings are apparent on the surface they are called sinks, and often appear without warning and in the most unexpected places. These sinks are frequent in the northern Gulf counties and in parts of Western Florida. They are often merely breaks exposing the currents of underground rivers, but sometimes they open down into still pools of wonderfully limpid water. These are called wells, as contradistinguished from the ordinary sinks.

Rivers.—The peninsula proper has three large river systems, two of which run N., namely, the St. John's along the Atlantic coast and the Withlacoochee along the Gulf coast, while the Kissimmee, having its sources between the two, runs far S. into Lake Okeechobee and the Gulf. This intersection of river systems is very remarkable, considering the generally level character of the country. The St. John's river is navigable for large steamers some 220 miles from the sea, and the other rivers named for smaller craft. The St. Mary's river (navigable) separates Florida from Georgia on the N. E., but hardly belongs to the Florida system.

West Florida is traversed by three large rivers, all having their sources in the States lying to the N.; these are the Suwannee, the Appalachicola, and the Chattahoochee; all are navigable, and, as they drain extensive watersheds, are subject to high freshets. Besides those named, there are countless small streams navigable for small boats, and of more or less use commercially for rafting lumber and for traversing otherwise almost impenetrable regions.

Bays, Harbors, etc.—The harbors of the Atlantic coast are mostly shallow and difficult of access, owing to shifting sand-bars and the varying conditions induced by slight changes of the wind. The best are at Fernandina, at the mouth of the St. Mary's river, and at the mouth of the St. John's river, where artificial improvements have been made. At St. Augustine is a natural harbor, but it is only at the most favorable times that sea-going vessels can enter it. S. of this there are only shallow inlets until Biscayne Bay is reached, where vessels drawing 9 or 10 feet of water can at all times gain access to a secure anchorage. Along the Florida reefs are numerous harbors of refuge among the keys. Conspicuous among these is Turtle harbor, shown on the coast survey charts, but most of them are known only to local pilots. At Key West is an excellent harbor. On the Gulf coast of the peninsula are Charlotte harbor and Tampa Bay, both accessible for large sea-going craft. Pensacola, on the northern Gulf coast, has a superb natural bay and harbor where vessels of large size can enter at all times. Along the greater part of the Florida coast are islands and reefs lying a short distance from the main land and forming sheltered inlets that are called rivers, lakes, harbors, or bays according to individual conformation. These are mostly shallow, but are generally navigable for vessels of light draught; such are Indian river, Lake Worth, Charlotte harbor, and Sarasota Bay.

The Florida Keys.—(The name "key" is from the Spanish *cayo*, island.) This remarkable coral formation marks the northern limit of the Gulf Stream, where it rushes out from its source in the Gulf of Mexico and begins its northern course through the Atlantic Ocean. The Straits of Florida are among the most dangerous known to navigators, although they are well lighted and charted. The islands are nowhere more than 8 or 10 feet above the sea, but they are often covered with a luxuriant growth of tropical vegetation. From the Dry Tortugas to Sand's Key, at the entrance to Biscayne Bay about 200 miles, is a continuous reef of coral, upon the whole extent of which the little coral-builder is still industriously at work. The reef is broken here and there by channels of greater or less depth, and within the outer line are many habitable islands. The whole space within the outer reef is no doubt slowly filling up, just as the islands are slowly growing through the accretion of floating substances that become entangled in the roots of mangrove-trees. The present Florida reef is no doubt an example of the way in which a large part of the peninsula was formed. No less than seven old coral reefs have been shown to exist south of Lake Okeechobee, and the present one, being at the very edge of the deep water of the Gulf Stream, is probably the last that can be formed, since the coral-builder can not live at a greater depth than 60 feet. The current of the Gulf Stream is so swift now along the outer reef that there is no longer a solid foundation upon which to build.

Geology and Mineralogy.—The Upper Eocene, or Vicksburg limestone, forms the substratum throughout most of the State, but along the coasts and to the southward are extensive formations of Postpliocene coralline limestone. Important discoveries of high grade phosphate rock were made in 1888, and an extensive export trade has since developed. The phosphates are classified as "hard rock," soft rock, land pebble, and river pebble. The hard rock is found in a belt sweeping to the S. and E. from the vicinity of Tallahassee to the southeastern part of Pasco County. To the S. and E. of this belt are great islands of the land and river pebble. Vertebrate remains occur in abundance, and the proportion of phosphate of lime is from 50 to 80 per cent.

Soil, Productions, etc.—To the superficial observer the soil of Florida is a vast tract of sand, but out of this spring all kinds of vegetation in great luxuriance. The surface soil, in fact, depends largely on the character of the underlying rock, which is everywhere limestone, varying in its constituents, but often rich in phosphates. These mingling with vegetable humus cover wide tracts with a soil of unsurpassed productiveness. Classified by the natural tree-growths three general divisions of land are indicated:

1. Oak, hickory, and pine uplands, mainly the northern tier of counties, but with detached examples in Middle Florida.
2. The long-leaved pine regions, including the best parts of peninsular Florida (28,000 sq. miles).
3. Pitch-pine, treeless, and alluvial. Mainly coastwise, but including swamps, everglades, savannas, and flatwoods, largely worthless, but partly arable or reclaimable.

The agricultural productions include cotton, pears, and peaches for the northern counties; vegetables of all kinds for the middle peninsula region; and oranges and citrus fruits of all kinds for the entire State, except the extreme northern portion. The best oranges are grown in the semi-tropical region of Middle Florida, where there are occasional frosts. In sub-tropical Florida pine-apples, cocoa-palms, mangoes, guavas, and almost all tropical fruits either grow naturally or are cultivated with great success. Hammock lands, considered the best for all agricultural and horticultural purposes, are easily distinguishable from pine lands by the prevailing growth of hard woods and cabbage-palms. "Hammock" is the sole survival of the Lucayan tongue and should not be confounded with hummock. Its alleged meaning is "a place where hard wood grows."

Zoölogy.—Among animals, deer, bear, panther, wildcat, raccoon, opossum, squirrels, otter, wolves, foxes, etc., abound in the sparsely settled tracts. Of birds, there are the turkey, duck, quail, pigeon, and nearly all varieties of snipe and plover. Birds of brilliant plumage have been nearly exterminated in the interests of millinery. The roseate spoonbill, the flamingo, the rarer curlews, egrets, paroquets, etc., are found only in the heart of the wilderness. The manatee, or sea-cow, is found in the salt and fresh waters of Middle and Southern Florida. It has been practically exterminated by wanton gunners in the more frequented regions. Crocodiles (*Crocodilus acutus*) exist in considerable numbers in one or two localities in the extreme south. The common alligator (*Aligator mississippiensis*) is found in all the lakes, streams, and swamps of the State, though comparatively rare since the introduction of breech-loading firearms and the growing demand for alligator hides. Fish abound in all the waters of Florida. Mullet, shad, sea-trout, bass, pompano, red-snapper, and sheepshead are among the most valuable food-fishes, and are largely exported for foreign consumption. From the sportsman's point of view tarpon and kingfish are chief among the game varieties, but they are not valued for the table. Pompano may be taken with the rod, and are among the most delicious of table fish. Sea-turtles abound along all the coasts during the egg-laying season, and terrapin are found in the inland waters. A large species of land-turtle, locally known as "gophers," frequent the forests, burrowing into the earth for refuge from their many enemies. Rattlesnakes and moccasins are the only venomous varieties of snakes, and these are rarely seen except during the warm months, say from May to October inclusive.

Climate.—Though Florida extends over six degrees of latitude, its climate is very uniform. The extreme range of temperature in Northern Florida is from 90° to 26° F., and in central and Southern Florida from 90° to 43° F., the summer average nowhere exceeding 84° F. The rainfall exhibits greater variations. At Tarpon Springs it averaged 84.5 inches for five years.

The following table, compiled from the U. S. Weather Bureau reports, shows (1) the average number of clear or fair days in the year, (2) the annual average rainfall, and (3) the annual average temperature at five of the Weather Bureau stations:

PLACE.	Annual average number of clear days.	Annual average rainfall in inches.	Annual average temperature in degrees Fahr.
Jacksonville	280·1	54·70	69·30
Sanford	322·0	45·72	71·75
Cedar Keys	311·0	55·86	71·12
Key West	307·7	40·31	77·57
Pensacola	274·6	67·31	68·42

Divisions.—Topographically the State naturally divides itself as follows: 1, The Atlantic coast; 2, the Gulf coast; 3, Middle Florida (including the "orange belt" and the best agricultural tracts); 4, sub-tropical Florida (S. of lat. 27° N., generally defined as the habitat of the cocoa-palm); 5, West Florida (including the northern Gulf coast and that part of the State not belonging properly to the peninsula).

For administrative purposes the State is divided (1900) into forty-five counties, as follows:

COUNTIES AND COUNTY TOWNS, WITH POPULATION.

COUNTIES.	* Ref.	Pop. 1890.	Pop. 1900.	COUNTY TOWNS.	Pop. 1900.
Alachua	3-I	22,934	32,245	Gainesville	3,633
Baker	2-I	3,333	4,516	Maclenny	350
Bradford	2-I	7,516	10,295	Starke	972
Brevard	6-L	3,401	5,158	Titusville	756
Calhoun	2-E	1,681	5,132	Blountstown	571
Citrus	5-I	2,394	5,391	Inverness	600
Clay	3-J	5,154	5,635	Green Cove Sps	929
Columbia	2-I	12,877	17,094	Lake City	4,013
Dade	9-L	861	4,955	Juno	.....
De Soto	7-J	4,944	8,047	Arcadia	799
Duval	2-J	26,800	39,733	Jacksonville	28,429
Escambia	1-B	20,188	28,313	Pensacola	17,747
Franklin	3-F	3,308	4,890	Appalachicola	3,077
Gadsden	2-F	11,894	15,294	Quincy	847
Hamilton	2-H	8,507	11,881	Jasper	993
Hernando	5-I	2,476	3,638	Brooksville	641
Hillsborough	6-I	14,941	36,013	Tampa	15,839
Holmes	1-D	4,336	7,762	Cerro Gordo	.....
Jackson	1-E	17,544	23,377	Marianna	900
Jefferson	2-G	15,757	16,195	Monticello	1,076
Lafayette	3-H	3,686	4,987	Mayo	....
Lake	5-J	8,034	7,467	Tavares	113
Lee	9-K	1,414	3,071	Myers	943
Leon	2-F	17,752	19,887	Tallahassee	2,981
Levy	4-H	6,586	8,603	Bronson	799
Liberty	2-F	1,452	2,956	Bristol	796
Madison	2-G	14,316	15,446	Madison	849
Manatee	7-I	2,895	4,663	Braiden Town	900
Marion	4-I	20,796	24,403	Ocala	3,380
Monroe	8-C	18,786	18,006	Key West	17,114
Nassau	1-J	8,294	9,654	Fernandina	3,245
Orange	5-K	12,584	11,374	Orlando	2,481
Osceola	6-K	3,133	3,444	Kissimmee	1,132
Pasco	6-I	4,249	6,054	Dade City	509
Polk	6-J	7,905	12,472	Bartow	1,983
Putnam	3-J	11,186	11,641	Palatka	3,301
St. John	3-J	8,712	9,165	St. Augustine	4,272
Santa Rosa	1-C	7,961	10,293	Milton	1,204
Sumter	5-J	5,363	6,187	Sumterville	886
Suwanee	2-H	10,524	14,554	Live Oak	1,659
Taylor	2-G	2,122	3,999	Perry	1,314
Volusia	4-K	8,467	10,003	Deland	1,449
Wakulla	2-F	3,117	5,149	Crawfordville	.....
Walton	1-D	4,816	9,346	De Funiak Sps	.....
Washington	2-D	6,426	10,154	Vernon	141
Totals		391,422	528,542		

* Reference for location of counties, see map of Florida.

Principal Towns (*1900*).—Tallahassee (capital), 2,981; Jacksonville, 28,429; Pensacola, 17,747; Key West, 17,114; Tampa, 15,839; St. Augustine, 4,272; Lake City, 4,013; Gainesville, 3,633; Ocala, 3,380; Palatka, 3,301; Fernandina, 3,245; Appalachicola, 3,077; and Orlando, 2,481.

The industrial and business interests of Florida depend largely upon the crops. First in importance is the orange crop, which in round numbers approximates two and a half million boxes annually for export. The raising of early vegetables, including strawberries, for the Northern market is a large and profitable business. Pineapples and cocoanuts are largely exported from the sub-tropical section. Tobacco-growing and the manufacture of cigars employ several thousand operatives. The cotton crop is annually increasing, and factories are springing up in the western counties. The chief crops in 1900 were: cotton, 41,855 bales, value $2,189,805; oats, 378,211 bush.; potatoes, 104,280 bush.; hay, 6,418 tons. The lumber interests are of great value, Pensacola being the chief port of shipment. Considerable business interests have recently developed in the manufacture of textile goods from palmetto fiber. The sponge-fishery is carried on from Cedar Keys on the Gulf coast to and along the Florida Straits, and as far up the Atlantic coast as Biscayne Bay. Key West is the principal market and shipping-point for sponges. The manufacture of "koonti," or "coontie," a flour resembling corn-starch, is largely carried on in sub-tropical Florida. This is made from the root of a wild plant (*Zamia integrifolia*), and is exported in considerable quantities. See Florida in the Appendix.

Finances.—Assessment returns for 1899 showed the following valuations: Real estate, $59,177,137; telegraph lines, $252,736.15; railways and rolling stock, $18,759,125.64; and personal property, $15,338,355—total, $93,527,353.79. The total assessed valuation for 1900 was $96,518,953.73. The tax rate for all purposes was $5 per $1,000 of valuation. The total bonded indebtedness of the State in 1899 was $322,500. This amount has since been greatly reduced.

Banks.—On June 30, 1900, there were 15 national banks with a combined capital of $1,150,000; surplus and undivided profits, $772,902.74; and individual deposits, $6,431,-498.44; 23 State banks with $742,500 capital; $234,510 surplus and profits; and $3,489,436 deposits; and 1 savings bank with $20,000 capital stock; $9,883 surplus; and $225,-395 in savings deposits. Five of the State banks are savings banks or have savings departments.

Means of Communication.—Natural means of communication are the waterways partially described under *Topography*. These have in some cases been improved, as by jetties at the mouth of the St. Johns, by several canals along the Halifax and Indian rivers, and by improvements in several of the rivers and harbors. In 1900 there were in the State 3,109.70 miles of railroad. The principal lines are Jacksonville, Tampa and Key West, with branches; Jacksonville, St. Augustine and Indian River; Florida Central and Peninsula; Louisville and Nashville; Florida Southern. Besides these there are numerous smaller roads intersecting the northern and central parts of the State. In 1900 there were 3,148.40 miles of telegraph lines.

Churches and Schools.—The Methodist Episcopal Church South is the strongest denomination in the State. The census of 1890 gave the following statistics of the Churches: Methodist Episcopal Church South—organizations, 389; churches and halls, 370; members, 25,362; value of church property, $333,824; African Methodist Episcopal—organizations, 152; churches and halls, 269; members, 22,463; church property, $168,473; Baptist, colored—organizations, 327; churches and halls, 330; members, 21,711; church property, 137,578; Baptist, white—organizations, 403; churches and halls, 403; members, 18,747; church property, $208,933; Roman Catholic—organizations, 44; churches and stations, 38; members, 16,867; church property, $225,100; African Methodist Episcopal Zion—organizations, 61; churches and halls, 61; members, 14,791; church property, $90,745; Methodist Episcopal—organizations, 117; churches and halls, 112; members, 5,739; church property, $219,000; Protestant Episcopal—organizations, 100; churches, 84; members, 4,225; church property, $390,-561; and Presbyterian in the U. S.—members, 3,444; Colored Methodist Episcopal, 1,461; Disciples, 1,306; Congregational, 1,184; and Presbyterian in the U. S. of America, 1,042.

The school census for the school year 1899–1900 gives the number of children of school age as follows: White males, 48,023; white females, 45,328; total white, 93,351. Negro males, 33,689; negro females, 34,388; total negro, 68,077. Total males, 81,712; total females, 79,716. Grand total, 161,428. In 1897–98 there were 108,455 children enrolled in the public schools; white males, 35,116; white females, 32,541; negro males, 19,632; negro females, 21,116. Total revenue, $630,733; expenditure, white, $565,465, colored, $171,486. Number of schoolhouses, 2,121: value of school property, $755,824; number of teachers, male 1,121, female 1,671; average pay of male teachers a month, $35.04, female teachers, $32.40.

Other public institutions are: East Florida Seminary, at Gainesville; Duval High School, at Jacksonville; Osceola High School, at Kissimmee; high school, at Lady Lake; Jefferson Collegiate Institute, at Monticello; high school, at Palatka; high school, at St. Augustine; West Florida Seminary, at Tallahassee; academy, at Union; and academy at Waukeenah. There are also a State Agricultural College at Lake City; Normal College for White Teachers, at De Funiak Springs; Normal College for Colored Teachers, at Tallahassee; John B. Stetson University, at De Land; Florida Conference College, at Leesburg; Rollins College, at Winter Park; Cookman Institute, at Jacksonville; Convent of Mary Immaculate, at Key West; and Convent of the Holy Names of Jesus and Mary, at Tampa.

Charitable, Reformatory, and Penal Institutions.—The principal ones are the State Lunatic Asylum, at Chattahoochee; the State Institute for the Deaf and Dumb, at St. Augustine; and the State Prison, the inmates of which, since Jan. 1, 1890, have been leased to contractors, and put to work on farms, on turpentine farms, and in the phosphate mines.

History.—It is not unlikely that Florida was seen by Europeans as early as 1497 (by Sebastian Cabot) and during the decade following by Spanish and Portuguese traders. But the accepted date of discovery is Mar. 27, Easter Sunday of 1513, when Juan Ponce de Leon sighted the coast near St. Augustine, and named it in honor of the day. In a search for gold and for the fountain of perpetual youth Ponce de Leon and his successors explored a large part of Florida. He met his death in a fight with the natives in Feb. or Mar., 1521. In 1528 Panphilo de Narvaez, with a fleet of five vessels and a force of 400 men, landed on the west coast, perhaps at Clear Water harbor. The fleet was sent along the coast while the army marched inland and perished, all save four who escaped after eight years of captivity. In 1539 Fernando de Soto landed at Tampa Bay with a force of nearly 600 men. He marched northward and westward, passing soon beyond the confines of Florida. He treated the Indians, friend and foe alike, with great violence, and laid the foundation for the distrust and hatred with which the Spaniards were ever after regarded. In 1564 the French, under René de Laudonnière, a Huguenot, attempted permanent settlement near the mouth of the St. Johns river. Two years afterward this colony was exterminated by Pedro Menendez d'Aviles, who hanged such of the garrison as were not killed in the action. Fortune also enabled him to capture other detachments of the French who were absent in their ships, and were shipwrecked on the coast south of St. Augustine. These men, too, he ruthlessly put to death, confessedly because of their Protestant faith. The fort built by the French was made a permanent post by the Spaniards, who fortified and garrisoned the headlands at the mouth of the river. The story of Menendez's atrocities was received with indignation in France, but such was the fear of Spain that the king dared do nothing in revenge. A private gentleman, however, Dominique de Gourgues by name, organized a force at his own expense, captured the Spanish forts on the St. Johns river, and hanged the survivors of the fight on the very trees that had been employed by Menendez for a like purpose. The French from this time practically withdrew from Florida, and, excepting occasional descents by Drake and other English freebooters, the Spaniards enjoyed uninterrupted possession. They reduced many of the natives to slavery, and treated them with such outrageous cruelty that the race rapidly deteriorated. Nominally, however, the whole period of Spanish occupation was sanctioned by the Church, and many zealous missionaries perished at the hands of the Indians while endeavoring to carry their religion into remote regions. New settlements were made at Pensacola and at various points elsewhere along the coasts. In 1687 the first large consignment of Negro slaves was brought to Florida. In 1702 the British, under Gov. Moore, of South Carolina, laid siege to St. Augustine by land and sea, and during the twenty years that followed hostilities were frequent between the Spanish, French, and British along the Florida coasts. No formal declaration of war was made, however, until 1739, when active hostilities were opened, and in 1740 St. Augustine was formally besieged by the English. A defense was successfully conducted by the Spanish garrison under Don Manuel de Monteano. Hostilities continued until 1748, when a truce was agreed upon between Great Britain and Spain, which lasted until 1762, and war was renewed, resulting in the exchange of Cuba for Florida, and the British immediately took possession. Then began for Florida a period of prosperity, during which a number of industrious settlers established homes in the new colony. The wonderful productiveness of the soil, unsuspected by the Spaniards, was promptly recognized, and there was every indication that a prosperous agricultural community would be permanently established. The American war for independence scarcely affected Florida. Shortly after the independence of the American colonies was recognized, Florida was ceded back to Spain, greatly to the disadvantage of the British subjects, who were allowed eighteen months to remove their effects, and were assisted by the crown. Those who remained were treated most abominably by the Spaniards, and were practically expelled from the country, often with the loss of their property. A new period of decadence under Spanish rule immediately set in. In 1795 Spain sold West Florida to France. In 1811, in view of probable war with Great Britain, the U. S. resolved to seize Florida in order to prevent the British from taking possession. A British force occupied Pensacola with the consent of the Spanish authorities in 1814, but in November of that year the place was captured by Gen. Andrew Jackson, and the British garrison expelled. Then followed a long series of wars with the native tribes, and in 1819 the whole of Florida was finally ceded by Spain to the U. S. On July 10, 1821, the Spanish flag was hauled down and the U. S. flag hoisted at all military stations. In 1822 Florida was organized as a Territory of the U. S. From 1835 to 1842 the State was the scene of almost constant Indian wars. The Seminoles were a gallant and warlike race, and inaugurated hostilities by waylaying a detachment of U. S. troops under Maj. Dade, 110 strong. Four of this detachment escaped by feigning death. Eventually the Seminoles surrendered and were removed to a special reservation. About 360 of them, however, remained in the Everglades, where their descendants still reside. In 1845 Florida was admitted to the Union as a State. In Jan., 1861, the various U. S. posts were seized by State troops under authority of the Governor, and on the 10th of the month the ordinance of secession was adopted in convention at Tallahassee. Fort Pickens, at Pensacola, the only garrisoned fort, was held and eventually re-enforced, and after sustaining a severe bombardment by the Confederates became a base of operations for the Union forces in the vicinity. Various minor engagements occurred at different places along the coast and on the navigable streams. Jacksonville was several times occupied and evacuated by the contending forces. St. Augustine was seized by a Union force early in the war and held until its close. The most considerable engagement was the battle of Olustee, near Ocean Pond, Baker County, on Feb. 20, 1864, which resulted in the defeat of the Union force. The Confederates under Gen. Joseph Finnegan lost 934 men, the Union troops under Gen. Truman Seymour 1,828 men. On July 4, 1868, the Fourteenth Amendment to the Constitution of the U. S. having been adopted with a constitution comporting with the new order of things, Florida was readmitted to the Union.

GOVERNORS OF FLORIDA.

Territorial.		David S. Walker	1866–68
Andrew Jackson	1821–22	Harrison Reed	1868–Dec. 31, 1872
William P. Duval	1822–34	O. B. Hart	Jan., 1873–Mar., 1874
John H. Eaton	1834–36	M. L. Stearns	1874–77
Richard K. Call	1836–39	George F. Drew	1877–81
Robert R. Reid	1839–41	Wm. D. Bloxham	1881–85
Richard K. Call	1841–44	Edward A. Perry	1885–89
John Branch	1844–45	Francis P. Fleming	1889–93
		Henry L. Mitchell	1893–97
State.		William D. Bloxham	1897–1901
William D. Moseley	1845–49	William S. Jennings	1901–
Thomas Brown	1849–53		
James E. Broome	1853–57		
Madison S. Perry	1857–61		
John Milton	1861–65		
Wm. Marvin, *Provisional.*	1865–66		

Antiquities.—There are evidences in various parts of Florida that the country was once occupied by an industrious and almost semi-civilized race. Mounds and cultivated tracts, "old fields" so called, show that the people must have been numerous, and have had some ideas as to engineering and agriculture. There are one or two very large works, apparently canals, now overgrown with luxuriant vegetation, but which were apparently intended to facilitate the commerce of some prehistoric time. The accounts of the early explorers, especially the French, who established far more friendly relations with the natives than did the Spaniards, point to quite a high degree of cultivation. There are at St. Augustine some collections of relics that show the skill of the natives as artisans. Early evidences of European civilization are found in several old forts, notably that at St. Augustine, built of coquina. After various vicissitudes of siege and storm, it has been made a military post and measures have been taken for its preservation. Elsewhere, as at Biscayne Bay, there are ruins of stone buildings, no record of which has been preserved, and which were probably the work of settlers afterward exterminated by the Indians. Similar ruins are found on several of the keys. Perhaps the most noteworthy antiquities consist of the enormous shell-mounds that exist all along the coast. These are of great magnitude, and are evidently mainly the natural accumulations of oyster-shells thrown here in vast quantities by the Indians, who made shellfish a principal article of diet. Besides these there are so-called domiciliary and burial mounds, in which have been found stone implements and other proofs of mechanical skill.

AUTHORITIES.—John Bartram, *Journal* (London, 1766); Daniel G. Brinton, *Notes on the Floridian Peninsula* (Philadelphia, 1859); Francis Parkman, *Pioneers of France in the New World* (Boston, 1865); George Rainsford Fairbanks, *History of Florida* (Philadelphia, 1871); James Wood Davidson, *Florida of To-day* (New York, 1889); Charles Ledyard Norton, *Handbook of Florida* (London and New York, 1890). CHARLES LEDYARD NORTON.

Florida Agricultural College: an educational institution situated in Lake City, Fla.; organized in 1884; president, W. F. Yocum, D. D. It has thirteen professors, a military department, and four courses of instruction in classical and literary, agricultural, mechanical, and civil engineering, and is supported partly by State appropriation but mainly by endowment from the general Government. A State experiment station is located on the grounds, which comprise 112 acres. The college has six buildings, a full equipment of apparatus, a library, museum, etc. In 1900 there were 226 students. Tuition is free to residents of the State.

Florida Blanca, JOSÉ MOÑINO, Count of: statesman; b. in Murcia, Spain, 1728; graduated at the University of Salamanca and studied law; became a successful advocate, and secured an appointment as fiscal to the tribunal of Castile. While administering this office he wrote a report on the subject of the Jesuits which brought him to the favorable notice of the Government and led to his appointment as ambassador to Rome in 1777, where his skillful diplomacy established friendly relations between his country and the holy see. Soon after his return he was appointed by Charles III. his chief minister of state. His administration, especially in domestic affairs, was remarkably successful. He reformed abuses in the administration of justice, improved the means of transportation, reduced the taxes, promoted industries, and encouraged learning and art. While his foreign policy bore good fruit in the treaties of commerce with the Porte, in the alliance with Portugal, and in the repression of Algerine piracy, his enemies accused him of bringing on the disastrous war with England 1779–83, and the bombardment of Algiers and attempt on Gibraltar cost his country 80,000 lives without advantageous result. After the death of Charles III. he retained his position with the imbecile Charles IV., but lost much of his influence, though a strong supporter of monarchical rights, and when in 1792 he tried to destroy the queen's influence with the king, his enemies procured his dismissal from court. He was imprisoned in the castle of Pampeluna and treated with great cruelty, but finally allowed to retire to his estates. At the time of the French invasion in 1808 he was chosen president of the Junta, Sept. 25. D. Nov. 20, 1808. F. M. COLBY.

Florida, Cape: See CAPE FLORIDA.

Florida Keys: See FLORIDA.

Florideæ: the only order of the class *Rhodophyceæ* or RED SEAWEEDS (*q. v.*).

Flor'in [from O. Fr. *florin*, from Mediæv. Lat. *flori'nus* (whence Ital. *fiorino*), deriv. of Lat. *flos, floris*, flower, because of the lily-flower stamped on the coin]: a Florentine coin first struck in gold in 1254. Gold and silver coins called florins, and of various values, have since been coined in many countries. England struck a gold florin in 1343. At present the British two-shilling silver piece, first coined in 1849, bears the official name of florin. It has nearly the value of the Austrian new silver florin, a unit of account, worth 48·6 cents of U. S. money.

Flori'nus: a Roman presbyter and heresiarch in the latter half of the second century, who was deposed by Eleutherius. His heresy was a form of Gnosticism (see GNOSTICS), and was essentially the same as that taught by Valentinus.

Flo'rio, JOHN: philologist and grammarian; was b. in London about 1552 of Italian parents, who, as Waldenses, had sought refuge in England from religious persecution; resided for a time at Oxford, and in 1578 published his *First Fruits which yield Familiar Speech, Merry Proverbs, Witty Sentences and Golden Sayings*, which was accompanied by *A Perfect Induction to the Italian and English Tongues*. This was followed by a similar work in 1591, and by an Italian and English dictionary in 1598 under the title of *A World of Words*. He enjoyed the patronage of several persons of high rank, and after the accession of James I. was appointed instructor to the young prince, and later gentleman of the privy chamber and clerk of the closet to the queen. He is best known for his English translation of Montaigne's *Essays*, published in 1603. D. at Fulham in 1625.

Florio, CARYL: composer, organist, and teacher; b. in Tavistock, England, Nov. 3, 1843; went to New York with his parents in Sept., 1858. In his boyhood he had a remarkable soprano voice, and was a member of Trinity church choir 1858–1860, under the family name of Robjohn. Studied under Dr. Edward Hodges and Dr. Henry Stephen Cutler, successively organists of Trinity church. He has been organist of Zion church and the "Brick" Presbyterian church in New York. His compositions include two operas, two symphonies (all in MS.), several cantatas, many anthems, services, and hymn tunes for church service, and he has edited a volume of *Children's Hymns with Tunes*. He resides in New York city. D. E. HERVEY.

Flo'ris, FRANÇOIS, called *Franc-Flore*, or *Franc-Floris*: b. at Antwerp in 1520; the family name was *De Vriendt*. He began studying sculpture with his father, but at the age of twenty, preferring painting, he became a pupil of Lambert Lombard, at Liége. Soon surpassing his master, he was elected member of the Antwerp Academy, and went to Rome, where he studied the antique and adopted the manner of Michaelangelo. On his return to his country his skill and rapidity of execution acquired fame and riches immediately for him. When Charles V. made his entry into Antwerp Floris designed and executed the triumphal arches erected in honor of this monarch. He was again called upon for similar work for Philip II., and Philip desired to engage him for his court painter, but he refused to leave his own country, where he died of drunkenness at the age of fifty. His chief works are *St. Michael*, for the confraternity of St. Michael at Antwerp, *The Last Judgment*, for a church at Brussels, now in the Louvre, and a triptych at Ghent representing the life of St. Luke; also the nine muses in Middelburg. D. in 1570. W. J. STILLMAN.

Flo'rus: a Roman historian, whose full name is a matter of dispute. In the earlier editions of his history he appears as L. Annæus Florus, and is supposed to have been a member of the family to which Seneca belonged. Duker, following Vossius (*Hist. Lat.*), infers from his style, family name, and the age in which he lived, his identity with the poet Annius Florus, who interchanged sportive verses with the Emperor Hadrian. In the preface to his work he speaks of a revival of Roman vigor under Trajan, and would seem therefore to have lived in his reign or in that of Hadrian. Titze, however, rejecting the passage as an interpolation, maintained that he is the Lucius Julius Florus to whom two of Horace's epistles are addressed, and places him therefore in the time of Augustus, a view no longer tenable. Wölfflin, in the *Archiv für Lat. Lexikographie*, vol. vi., pp. 1–7, has shown new ground for believing that the historian came from Africa, and is to be identified with the rhetorician and poet P. Annius Florus, the author of the dialogue as to whether Vergil was rather an orator or poet (*Vergilius orator an poeta?*), and probably also of the extant poem entitled *Pervigilium Veneris*. Florus's history is a concise and highly rhetorical account of the Roman people from King Romulus to Augustus Cæsar. In the earlier editions the work was entitled *Epitome Rerum Romanarum*, and was divided arbitrarily into four books. But Jahn and Halm, following the Bamberg codex, give the title *Epitomæ de Tito Livio Bellorum omnium Annorum DCC. libri duo.* The first book contains the account of the external wars of Rome, while the second deals chiefly with the domestic contentions and the seditions of the people, and the wars in which Augustus was engaged, ending with the closing of the temple of Janus as the token of universal peace. The work of Florus, taken, as the name indicates, in the main from Livy, is a concise but interesting record of the progress of the Roman people, written in a rather ambitious style, without much regard to accuracy of facts or of dates, and is to be regarded rather as a panegyric than a history. The best of the earlier editions are those of Duker (Leyden, 1722), and Titze (Prague, 1819); more recent and critical those of Otto Jahn (Leipzig, 1852), and of Halm (Leipzig, 1854). See *Das Geschichtswerk des Florus*, von J. Reber (Freising, 1865); C. Heyn, *De Floro Historico* (Bonn, 1866).

Revised by M. Warren.

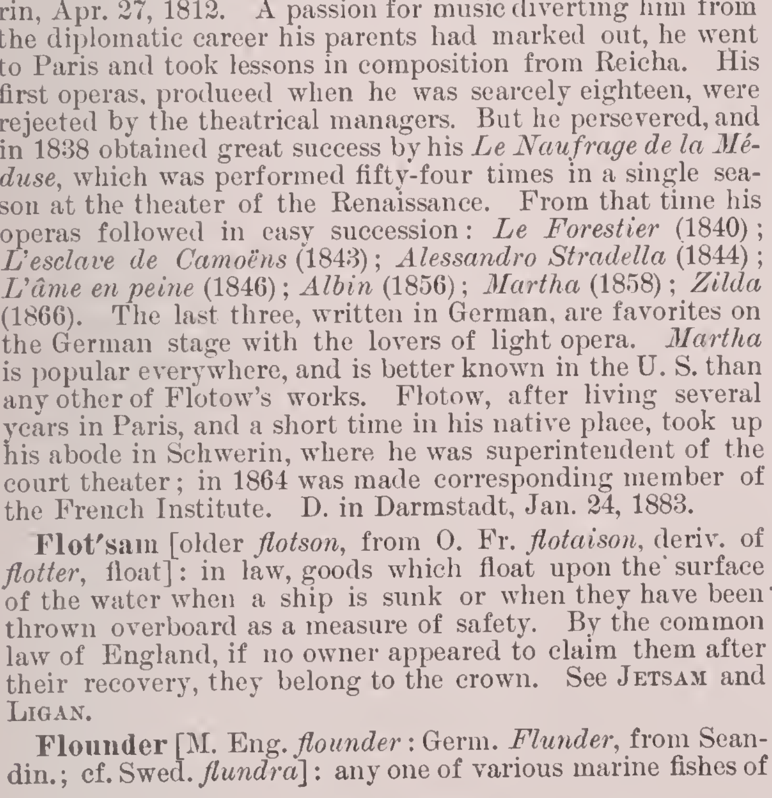
Florus, Drepanius: a Gallo-Roman divine of the ninth century, and a deacon at Lyons; remembered as the opponent of Gotteschalk and Scotus Erigena; against the latter he wrote *Liber de Predestinatione* (852). D. about 860.

Floss Silk [*floss* is from O. Fr. *flosche*, weak, soft, Ital. *floscio*, apparently descend. of Lat. *fluxus*, fluid, weak, under influence of *floccus*]: the soft, downy part of the silk which remains on the cocoon after all that can be reeled off has been reeled off. It is steeped in water, pressed, dried, oiled, carded, and spun into soft, loose yarn, used chiefly in embroidery.

Flotow, flō'tō, Friedrich Ferdinand Adolph, von: a German composer; b. at Teutendorf, in Mecklenburg-Schwerin, Apr. 27, 1812. A passion for music diverting him from the diplomatic career his parents had marked out, he went to Paris and took lessons in composition from Reicha. His first operas, produced when he was scarcely eighteen, were rejected by the theatrical managers. But he persevered, and in 1838 obtained great success by his *Le Naufrage de la Méduse*, which was performed fifty-four times in a single season at the theater of the Renaissance. From that time his operas followed in easy succession: *Le Forestier* (1840); *L'esclave de Camoëns* (1843); *Alessandro Stradella* (1844); *L'âme en peine* (1846); *Albin* (1856); *Martha* (1858); *Zilda* (1866). The last three, written in German, are favorites on the German stage with the lovers of light opera. *Martha* is popular everywhere, and is better known in the U. S. than any other of Flotow's works. Flotow, after living several years in Paris, and a short time in his native place, took up his abode in Schwerin, where he was superintendent of the court theater; in 1864 was made corresponding member of the French Institute. D. in Darmstadt, Jan. 24, 1883.

Flot'sam [older *flotson*, from O. Fr. *flotaison*, deriv. of *flotter*, float]: in law, goods which float upon the surface of the water when a ship is sunk or when they have been thrown overboard as a measure of safety. By the common law of England, if no owner appeared to claim them after their recovery, they belong to the crown. See Jetsam and Ligan.

Flounder [M. Eng. *flounder*: Germ. *Flunder*, from Scandin.; cf. Swed. *flundra*]: any one of various marine fishes of



Flounder (*Pleuronectes* or *Pletessa plesus*).

the family *Pleuronectidæ*. They are flat, and swim with one side, not one edge, uppermost; both eyes are on the upper side, and the lower side is much whiter than the other. Many species occur in American waters. See Fisheries.

Flour [from Fr. *fleur de farine*: Span. *flor de la harina*, lit. *flower of meal*]: the finely ground meal of wheat or of any other grain; especially the finer part of meal separated by bolting. When dry wheat is crushed as in mortar, or between revolving mill-stones, the product is a powder mixed with scales, known as whole meal. The process of sifting or bolting separates the whole meal into two portions, known as flour and bran. The latter consists of the outer woody portion of the grain, with adhering portions of the interior; and flour is the name given to the remainder. The latter is white, the former is reddish or grayish. This simple nomenclature was suited to the earliest forms of milling. It applies as well to rye, except in the matter of color, as to wheat, and more or less to other grains, and to some extent to seeds.

With refinements in the art of making bread, cake, and pastry came a demand for finer flours. New modes of milling were introduced, and the product was separated into more numerous grades. It was at one time customary in the U. S. to divide the product into three grades—flour, connell, and bran. The flour, including so much as could be separated of the requisite whiteness, amounting to some 70 per cent., was removed by bolting from the remainder; and this remainder, by passing over a coarser sieve, was divided into larger scales and fragments called bran, and lesser scales and fragments called connell. The latter is also known as shorts and middlings. These three have been further increased by improved appliances both in the U. S. and in Great Britain, and especially in Hungary. The grades of flour produced by the best mills are ten in number.

The principles which have guided the inventor of milling devices will be best understood after a study of the *structure of the wheat grain.* The grain of wheat has the form of an irregular oblong spheroid, having a longitudinal groove on one side, and terminating at one end in minute vegetable hairs or bristles, and at the other in a slightly corrugated surface covering the germ. If this grain be moistened and rubbed with a dry rough cloth there will be detached from the surface two outer coats composed of woody fiber. Within there is a thin coat, also composed of woody fiber, which, from the peculiar network of fibers and tubes, suggesting the appearance of cigars placed side by side, has been called the cigar-coat. This is succeeded by another coat of exceeding tenuity, like the others chiefly composed of woody fiber. Within these is the nutritious portion of the grain. There is first a framework of cells entirely enveloping the white portion of the flour. The cells are filled with a class of nitrogenous bodies of albuminous character and certain mineral salts, almost wholly phosphates, of which the chief is the phosphate of potassa, with much smaller proportions of phosphates of magnesia, lime, soda, and iron, the whole, with the cell framework, being known as the gluten coat. At the germ end of the berry, opposite the brush end, there are certain organic forms, constituting the embryo of the grain. The whole of the remaining interior is occupied by a framework of coarse, open cellular tissue, filled with starch grains, which are coarse, and others, exceedingly minute, containing albuminoid or nitrogenous constituents. If a sharp knife be passed through a plump berry of wheat perpendicular to its axis halfway from end to end, and the section so exposed be treated with solution of iodine, the entire surface bordered by the gluten coat, but not including it, will be changed from whiteness to dark purple, demonstrating the presence and extent of the starch. If another section be exposed to the action of a solution of blue vitriol in ammonia (ammonio-sulphate of copper), the starch of the interior will be but little affected, but the gluten coat which surrounds it will have become green, from the formation of phosphate of copper. A solution of ammonio-nitrate of silver (nitrate of silver dissolved in ammonia) will color the gluten coat yellow, from the formation of phosphate of silver. If the crushed berry be treated with weak acetic acid, and the result of the digestion be filtered and ammonia added to the clear liquor, there will be separated from the solution on standing minute crystals of phosphate of magnesia and ammonia. If a drop of nitrate of silver dissolved in water be poured upon the flour, no change will take place, but if nitrate of silver dissolved in ammonia be poured upon the flour it will yield, as already observed, the yellow compound of phosphate of silver. Strong nitric acid will color the flour orange, from its action on the albuminoid substances. If a quantity of flour intimately mixed with water to a stiff emulsion is set aside at a temperature of about 70°, it will after a while begin to evolve bubbles of gas, and after a longer time it will become acid and offensive to the taste, and the liquid will contain phosphoric acid, readily recognizable by chemical tests.

The phosphatic and nitrogenous constituents and the starch all have nutritive value, and are indispensable as elements of food. Of these the starch is far the most abundant, constituting about 70 per cent. of the whole grain. The nitrogenous constituents or the albuminoid bodies constitute from 11 to 18 per cent., and the phosphatic salts about 2 per cent., the rest being mainly woody fiber. Of the nutritious portions, weight for weight, the phosphatic constituents are undoubtedly entitled to the first rank. The portion of the nitrogenous constituents lodged with the phosphates in the cells of the gluten coat have been shown by Mègé Mouriés to be peculiarly susceptible to fermentation when exposed to a moist atmosphere. They are encased in capsules impervious to the air in the berry. If these capsules be ruptured or crushed, exposure to the air is inevitable.

On this structural peculiarity of the grain rests the foundation of a philosophical system of milling. The larger the percentage of the interior of the berry in flour, the less must be its nutritive value; and correspondingly, the larger the percentage of the gluten coat in flour—the chief deposit of the phosphates—the greater its nutritive value; and in bran, the smaller the percentage of adhering gluten, the more nearly worthless as an article of food the bran would be. If it were practicable to reduce the percentage of pure starch and increase the percentage of phosphatic and nitrogenous constituents, the nutritive value of the flour would be augmented.

The presence of minute particles of woody fiber in the flour gives to it a yellow shade. That system of milling which most nearly removes all the woody fiber, and none of the gluten or phosphates, from the flour, accomplishes one of the chief ends to be gained.

To appreciate the difficulties that present themselves to the inventor of milling machinery the berry should be considered as it is found in commerce. It is very rare that any considerable quantity of wheat is to be found in the market absolutely free from foreign ingredients, such as chaff, fragments of straw, oats, chess, mustard, cockle, grass-seed, sand, etc.; it is rarer still to find wheat grains uniformly filled out and without shriveled or blasted kernels. Wheat is sometimes plump, the starch of the interior being mealy, so that if the berry were cut in halves it would be easy with a pin to detach all the white interior, leaving two cups lined with the gluten coat and invested with the woody bran-case. The wheat is sometimes slightly shrunken, hard, and brittle from the surface to the center, and cuts like the rind of old cheese. It is sometimes shriveled, as if its growth had been arrested at the commencement of the period when the berry is in what is technically called "the milk," or as when it has been struck with rust—a microscopic vegetable growth accompanying the loss of milk from the berry. It is plain that shriveled berries in the process of milling would for the most part be resolved into fine bran, and so be with difficulty separated from the flour, and thus the flour be discolored and rendered less nutritious. It is plain, too, that the plump berry with the mealy interior would be easily mashed in the process of grinding, while the hard, brittle berry would more easily be cracked.

Purification of Commercial Wheat.—Two principles underlie most of the devices for separating the light grains from the heavy, and the foreign seeds, grains, and other impurities from the wheat. The one is the process of sifting—the other, that of exposing a thin cascade of falling grain to a current of air. To these a third has been added, that of centrifugal force, taking advantage of unequal specific gravity and unequal extent of surface. In the sifting process advantage is taken of the unequal sizes and of the different shapes of the bodies to be separated from each other. It is easy to see how light grains and chaff and bits of straw and dust would be further diverted from a perpendicular in falling through a stratum of air driven by a revolving fan. This principle was illustrated in the earliest times, when the mixed wheat and chaff were tossed together into the air, to be separated by the wind before reaching the ground, and is the principle underlying the ordinary fanning-mill. The separation of mustard and cockle and grass-seed from the wheat may be easily affected by passing the mixed grains over inclined plates perforated with holes large enough for the smaller seeds to pass through, but not large enough for the wheat. The oat grain is separated by taking advantage of its elongated form. The mixed oat and wheat grains are discharged in a thin sheet upon an inclined thin iron plate perforated with round holes at intervals nicely determined by experiment, abundantly large for the ready passage of both the wheat and oat grains if presented end foremost perpendicularly to the surface of the plate. But as the plate is inclined each berry must be tipped forward in order to enter a hole. An individual hole is of such diameter that when the wheat grain, sliding forward, carries its center of gravity beyond the support of the upper edge of the hole, the forward end of the grain has not reached the lower margin, and thus the wheat falls through. The oat grain, however, in sliding down the inclined plane, before its center of gravity has passed beyond the support of the upper margin of the hole, will, by reason of its prolonged keel, extend over the lower margin of the hole. As the oat advances the center of gravity will pass beyond the lower edge of the hole, and gain the support of the continuous surface before the tail of the berry will have lost the support of the upper edge. Fragments of straw and chaff pass on with the oats.

The dust, smut, and rust which may cling to the berry are separated by discharging the impure grain into the space between what may be regarded as a vertical cylinder, the surface of which is covered with brushes, and a closely fitting iron case perforated with numerous slits or holes, which serve the double purpose of making the surface rough and providing an escape for the separated dust. Round seeds are separated by taking advantage of the superior velocity they acquire in rolling down an inclined plane as compared with the long grains, which slide. The former leap an opening into which the latter drop.

By these and kindred processes it is now practicable to obtain good wheat from a sample of spring wheat of which not more than one-half is fit for making flour, by the complete separation of every foreign matter from the sound, serviceable wheat grains.

The wheat thus prepared is a structure the chemical, physiological, and mechanical composition of which has already been glanced at. If the grain of wheat be subjected to pressure, as in a vise, so that its diameter shall be lessened by a certain definite amount, the interior may be partially pulverized without rupturing the surface. If the pressure reducing its diameter by the same amount be of the nature of impact or of a blow, the interior will be cracked, but not pulverized, with the probable rupture of the surface. If the pressure of the vise be continued until the grain is flattened, the product will be large scales and powder. If the blows be repeated with change of position of the berry, the product will be dust, fragments including the inner layers of the bran, the gluten coat, and starch extending to the center of the berry, and the outer scales of the woody covering more or less separated from the gluten coat. The product derived from pressure may by sifting be separated into its constituents of scales (or bran) and powder (or flour). The bran will contain a large proportion of the gluten coat; the flour will consist of starch, with associated albuminoids, and gluten-cells detached from the bran. In the case of reduction by blows the dust will be chiefly composed of starch (which, it will be understood, though by far the largest constituent, may contain a larger percentage of the nitrogenous constituents than the gluten coat), the scales will be mainly of woody fiber, and the lumps or groats will be composed of starch, with the associated albuminoids on the interior, more or less of the bran coat on the exterior, and the gluten coat between. The dust may be easily removed by bolting; the outer scales of bran, mainly of woody fiber, may be easily separated by a current of air directed upon a thin cascade of the mixture—the bran-scales, with a given weight of material, presenting a greater extent of surface to the blast than the compact granules from which they are to be discharged.

It is plain that, weight for weight, the groats contain much more nutritive matter relatively than either of the two portions which have been separated from them. If, now, these groats be subjected to attrition among themselves, their corners will be rounded off, the scales on the outside of the gluten coat will be more or less detached, and the starch on the interior will be more or less worn off. The tenacity of the gluten coat will tend to preserve its integrity, while the relative friability of the starch in the interior and the fibrous texture of the outer covering of the gluten coat will facilitate their separation under the influence of attrition. If, now, the process of attrition be intermittent and alternating with the process of bolting and the use of the fan-blower, the groats will ultimately assume the form of little concave disks, largely freed from the bran without, and for the most part freed from the starch within. As these alternating processes have been worked, there will have been produced successively a series of brans growing richer in gluten, and a series of starches growing richer in gluten, and a final result of groats consisting mainly of gluten, with scarcely any starch or bran.

The two plans of reduction thus illustrated may be regarded as exhibiting the principles underlying the extremes of high and low milling; in practice, however, no such extreme is attained. The best forms of low milling include more or less of the principle of impact, and the best forms of high milling take advantage more or less of the principle of pressure without impact.

Milling.—Old Process.—The trituration of wheat was formerly almost universally accomplished between what are called millstones, two short cylinders of hard stone placed one over the other, having the two horizontal surfaces between them peculiarly grooved to fulfill the office which they are expected to perform. To understand this office account must be taken of a property of the gluten to which no allusion has as yet been made. If a handful of flour be moistened with water and fashioned into dough, and then continuously kneaded in a slender stream of falling water, the starch will gradually be separated from the dough, and there will remain at length pure gluten, a singularly tenacious and homogeneous substance. On drying, this body will become quite hard and somewhat brittle. On subjecting it to moderate heat after it has been thoroughly dried at common temperatures, it will be found to lose weight. It will have parted with water of hydration. On withdrawing the heat the gluten will reabsorb this water of hydration from the air at common temperatures, and recover its original weight. In the same manner the gluten of the flour subjected to heat will part with its water of hydration; and this escape of water will be accompanied more or less with the rupture of the cells in which the gluten is encased. The openings through which the moisture has escaped will permit the air to enter, and with it more or less the germs of microscopic vegetation, which, taking root in the gluten, produce the well-known effect described in the term *musty*, the flour acquiring an unpleasant odor and an inferior taste, the gluten at the same time losing an appreciable portion of its tenacity, and the bread made from it acquiring a less palatable flavor and being less light.

It is obviously desirable, therefore, that in the process of grinding the wheat the wheaten meal should be subjected to as little friction with the millstones as may be, or within certain limits, successively to interrupt the process and allow the materials to cool. The surfaces of the millstones present a series of grooves, or lands and furrows. These are oblique in some instances, and curvilinear in others. Great ingenuity has been displayed in the conformation and arrangement of the grooves with a view to attaining the best results. If it were the sole object to have the wheat pass through the stones without abrasion, it is manifest that the best form of the groove would be that which a grain of wheat would pursue discharged from the hopper and traversing the surface of the millstone under the influence of the centrifugal force. This path has been ascertained by allowing grains of wheat coated with plumbago to fall upon a smooth millstone, the surface of which has been chalked, so as to receive the marking of the plumbago as the stone was revolved with its determined velocity. The calculated direction of this curve has been found to coincide very precisely with the path as ascertained by experiment. The curves of the upper (the running) stone being reversed, as compared with the curves of the lower stone, the action of the edges of the opposing curves is to some extent like that of shears, and when the grains have been broken they fall into the grooves of the lower stone, and are gradually pushed to the periphery with but little further friction. Among the best results that have been attained in this direction are those of the Istvan steam-mills at Debreczin in Hungary, in which with a stone 54 inches in diameter the width in grinding surface from the periphery inward is only 9 inches. This gives nearly 80 per cent. of flour, with 20 per cent. of bran and 3 per cent. of waste.

The primary function of the grooves is that of trituration. As the grooves present one vertical surface, from the bottom of which the depth lessens by an ascending inclined plane, it will be seen that the grooves in the upper and nether stones provide that in the process of milling the action shall be in some degree like that of shears, in some degree that of impact, and in some degree that of mashing; and the relative measure of these will be determined by the distance of the stones from each other when in service. The stones may be placed so far asunder that the wheat will pass through without being crushed at all. In this case the interval must exceed the greatest length of the kernel of wheat. With the distance a little less than this the brush at the end of the kernel opposite the embryo will be cut off. As the distance is further lessened the grains will be cracked, until they may be brought so near that the gluten cells will be crushed, and the moisture evolved from them, in consequence of the heat produced by friction, will soften the gluten and cause the stones to adhere and the milling to be arrested. Between these extremes the art of the miller so adjusts the distance and velocity that, taken in connection with the other mechanical appliances of his mill, he is enabled to turn out the best product, in condition and quality, which the grain submitted is capable of yielding.

New Process: *Grinding between Grooved Rollers.*—By experiments made at Minneapolis in 1878 and 1879 it was found that a system of gradual reduction upon rollers similar to what had for some time been used in Hungary and France was of advantage in milling spring wheat. This system received a great impetus at the Millers' Exposition at Cincinnati, O., 1880, and by 1887 the gradual-reduction system had been widely adopted in the U. S. In this process the millstones are replaced by pairs of small horizontal rollers, the surfaces of part of which are traversed by small, sharp grooves parallel to the axis of the rollers. These pairs of rollers are arranged in sets of three, one above the other, with considerable intervals between, so that the heat produced by the slight crushing will be counteracted as the product passes through the air on its way from one pair of rollers to the next. These pairs of rollers are adjusted so that the crushing effect of any one pair is slight, and as many as six or seven sets, making from eighteen to twenty-one pairs of rollers, are necessary to produce the various grades of flour.

The powerful and progressive movement of modern milling is due to several causes. Among these may be mentioned the increasing demand for high grades of flour free from bran and from woody fiber. The demand for this glutenous middlings flour becomes larger from year to year. It is not only desirable but necessary that, as a matter of economy, the yield and quality of wheat flour shall be improved, the cost of manufacture lessened, and the less available kinds of wheat be brought into use; and as a matter of business prudence each miller should keep as near as possible to the front rank in his trade. Competition, stimulated by ample rewards for successful invention, is fierce, intelligent, well organized, and backed with abundant capital; hence systems, processes, and devices follow each other with wonderful rapidity, and with marked and beneficial effects upon the rapidly advancing science of milling. A division line may be made between methods, and "old" and "new" process may be spoken of as meaning whole wheat milling and middlings milling, no matter by what machines effected; the terms "low" and "high" milling may represent the same distinction, and the latter may be divided into "single-reduction" and "gradual-reduction" processes. The term "Hungarian system" is loosely applied to roller middlings milling by gradual reduction, whereas the original Hungarian system was middlings milling by gradual reduction with burrs. As both "high" and "low" milling are effected with rollers, the matter is further complicated; and when it is considered that the various operations in any one method as a whole—say middlings milling—may be effected by combinations of successive devices, the entire process is so complicated that it can not here be described in detail. Thus the breaking of the wheat may be done on rolls or on burrs; the middlings reduction has equal choice, and the bran dressing may be by burrs, rolls, beaters, or brush machines. In general, it may be said that the harder the wheat is the better high grinding pays in connection with the roller system. The leading features of this system, sometimes called the Hungarian roller system, are as follows: 1. Systematic separation, scouring, and brushing of the wheat. In this it does not differ from any other good system of milling. 2. Wheat granulation by grooved chilled-iron rollers, employing at least five breaks, and rolls having from eight to thirty grooves to the inch, making but little flour and leaving the bran finished. 3. Separation of the light chaff from the breaks by aspirators. 4. Thorough and systematic grading and purifying the middlings by purifiers. 5. Sizing the large middlings by equally speeded, smooth, chilled-iron rolls, thus reducing their size and taking out germs and bran specks. 6. Reducing the fine clean middlings to flour by differentially speeded rollers. 7. Full and complete bolting or sifting after each of the above.

The present methods of manufacturing flour in a modern flouring-mill in the U. S. are identical with Hungarian process milling, excepting that in mills in the U. S. all manual labor is reduced to a minimum, and that machinery is employed in all stages of the process of manufacture to such an extent that the modern mill is practically automatic. Improvements are being constantly applied in simplifying the process of manufacturing, saving of power, and cheapening the cost of production. The mills of the U. S. generally make three principal grades of flour—viz., patent or middlings flour, bakers' or break flour, and low-grade or bran flour. Of 100 lb. of flour manufactured from ordinary milling wheat, 72 to 76 per cent. is middlings flour, 18 to 22 per cent. is bakers' flour, 4 to 7 per cent. is low-grade flour. Of 100 lb. of good wheat there is produced 76 lb. of flour of all grades, and 24 lb. is in the weight of bran, shorts, and waste. To make a barrel of flour 258 lb. of clean wheat are required. One indicated horse-power in a modern flouring-mill in 1893 is required for every three barrels of flour in twenty-four hours. The cost of water-power in the Western States to make a barrel of flour is between 1½ and 3 cents. The cost of steam-power is between 4½ and 6½ cents per barrel.

Grading Flour.—The relative quantities of the several grades of flour vary with the kind and excellence of the wheat employed. The following list, taken from the record of a mill near Trieste, will illustrate the refinement to which the art of milling has been brought:

Groats, A and B		2	per cent.	41 per cent. of extra flour.
Flour,	No. 0	5	"	
"	" 1	12	"	
"	" 2	6	"	
"	" 3	6	"	
"	" 4	5	"	
"	" 5	5	"	
"	" 6	14	"	38 per cent. medium and common flour.
"	" 7	9	"	
"	" 8	5	"	
"	" 9	10	"	
Bran		18	"	79 per cent.
Loss		3	"	

Of these quantities, in a comparison with a view to determine the best work of a system of milling, a mixture of the first total 45 per cent. is taken.

Judging Flour.—The excellence of flour may be judged in some degree by its shade of color—the presence of minute particles of bran tending to give it a yellowish hue; by its freedom from musty odor or taste—proving that it has not been overheated and is comparatively new; and by the elasticity and tenacity of the dough which it yields when mixed with a small quantity of water and kneaded. To this may be added the odor which the dough in thin layer yields when submitted for a brief time to a sharp baking temperature of about 400° F.

Composition of Flour.—It has been convenient to treat of the composition of wheat as including the outer envelope, bran; the inner envelope, the gluten coat; and the mass of the interior, the starch and associated albuminoids. Proximate physical analysis and detailed chemical analysis have shown a much greater variety than would be indicated by these three. Of the outer coats there are five that may be readily separated from each other—the gluten coat, consisting of the framework of cells and the capsules and their contents of minute grains that fill the cells, the loose cellular tissue spanning the whole interior of the berry and supporting the starch-cells and their contents: opposite the brush end, distinguished as a tuft of vegetable hairs, there is the complete structure of the embryo. The outer coats contain, besides the woody fiber and cellular tissue of their structure, various inorganic substances, including silica. The gluten coat contains, besides the framework of cellular tissue, various nitrogenous substances, the chief of which is gluten—albumen, gluten, mucin, and cerealine, which differ from each other mainly in their solubility in water and in their susceptibility to fermentation and disintegration. Besides these there are contained bibasic phosphates of potassa—the most abundant—then magnesia next—lime, soda, iron, in combination with which the nitrogenous bodies above mentioned seem more or less to play the part of bases; and in addition to these oil and sugar.

The interior, besides the open cellular tissue and starch-granules, contains albuminoid bodies, kindred with those of the gluten coat, and in some grains in larger proportion; and a small percentage of phosphates. The ratio of phosphates in the interior to the salts in the bran and gluten coats is about as 1 : 10. The embryo contains, besides its organic texture, the nitrogenous and phosphatic constituents found in the gluten coat.

The following analyses by Dempwolff show the percentages of the proximate constituents of the wheat, the nitrogen and phosphates in the different grades of wheat flour:

IN 100 PARTS ARE—	Water.	Ash phosphates.	Nitrogen.	Albuminoids.	Starch.	Cellulose.
Groats and extra imperial	10·6	0·41	1·80	11·7	70·0	7·29
Roll flour	10·5	0·60	2·08	13·3	67·2	8·40
Bread flour	10·7	0·96	2·40	15·4	63·4	9·80
Dark flour	8·5	1·55	2·30	14·9	61·0	14·05
Bran	10·7	5·46	2·20	14·3	43·6	25·95

The following analyses of the flour of the Pesth Walz Muhl (cylinder mill), made by the writer, show the relations of the phosphoric acid to the nitrogen in the different grades into which the flour is resolved in that renowned mill. It should be remarked that the so-called "groats" are masses of the interior of the berry:

NUMBERS.	Water.	Ash.	Phosphoric acid.	Nitrogen.	Albuminoids calculated.
Groats	10·57	0·42	0·20	2·24 / 2·27	14·65
No. 0	10·37	0·43	0·14	1·68	10·76
" 1	10·23	0·41	0·21	1·68 / 1·68	10·76
" 2	10·47	1·03	0·22	1·72	11·02
" 3	10·07	1·02	0·17	1·72	11·02
" 4	10·24	1·19	0·25	1·74	11·15
" 5	9·66	0·69	0·35	1·80	11·54
" 6	11·12	1·04	0·24	1·84	11·79
" 7	10·99	0·81	0·21	1·80	11·54
" 8	9·86	1·01	0·36	1·90	12·18
" 9, coarse bran	9·71	7·32	2·14	1·98	12·69
" 10, fine bran	11·01	4·21	0·70	2·20	14·16

The constituents of the gluten coat when moistened with water spontaneously undergo chemical changes. The starch and sugar by themselves, similarly treated, experience no change. But when the starch and gluten are mingled together and mixed with an adequate quantity of water, the changes which the nitrogenous bodies experience are transferred to the starch, and that is also converted into new substances. At a moderately low temperature the starch is converted into lactic acid. At a temperature of from 70° to 80° F. the starch is converted first into a kind of dextrin, then into grape-sugar, and then this grape-sugar into alcohol and carbonic acid; at a more elevated temperature butyric acid, succinic acid, hydrogen, with carbonic acid and other volatile products, are produced. In the art of bread-making advantage has been taken of this susceptibility to fermentation, producing volatile products, to give to the moistened flour or dough, and ultimately to the loaf, the quality of porosity or cellular structure. This quality of the loaf, as is well known, facilitates digestion. The later refinements in the production of fermented bread have been directed to securing from sound flour that kind of fermentation only which yields mainly alcohol and carbonic acid, and is called vinous fermentation. Incidentally with these products there is yielded a certain amount of gum, and sometimes of sugar, beyond that converted into alcohol and carbonic acid, and also an agreeable volatile essential oil or ether, which imparts to the fresh loaf a pleasant aroma. See BREAD, COOKERY, and FERMENTATION.

Revised by CHARLES A. PILLSBURY.

Flourens, floo'răăn', GUSTAV: *littérateur* and politician; son of Marie Jean Pierre; b. at Paris, Aug. 4, 1838; deputy professor at College of France in 1863; fought in Crete against the Turks, and was sent as minister plenipotentiary from Crete to the Greek Government 1865–68; took part in electoral movement at Paris 1868; was arrested Apr., 1869, and same year was wounded in a duel with Paul Granier de Cassagnac; took part in the communal insurrection in Mar., 1871, and was killed near Paris on Apr. 3, 1871. Author of *Discours du Suffrage Universel* (1865); *La Question d'Orient et l'Insurrection Crétoise* (1867); *Paris Delivrée* (1871), etc.

Flourens, Marie Jean Pierre: physiologist and author; b. at Maureilhan, France, Apr. 15, 1794; became M. D. 1813, and a resident of Paris 1814; admitted to the Academy of Sciences in 1828; Professor of Comparative Anatomy in 1832; perpetual secretary of the Academy of Sciences in 1833; member of French Academy in 1840. His *Researches on Irritability and Sensibility* appeared in 1822; *Researches on the Properties and Functions of the Nervous System in Vertebrate Animals* in 1824; *Analysis of the Labors of Cuvier* in 1841; *Buffon, Histoire de ses Idées et de ses Travaux*, in 1844; *Theory of the Formation of the Bones* (1847); *Course of Comparative Physiology* (1854), etc. Became peer of France 1846, and grand officer of the Legion of Honor Aug. 11, 1859. D. at Montgeron, near Paris, Dec. 6, 1867.

Flower [M. Eng. *flour*, from O. Fr. *flour*, *flur*, *flor* > Fr. *fleur* < Lat. *flos*, *flo'ris*, flower]: the aggregation of reproductive organs and accessory parts in the highest division of the vegetable kingdom (Anthophytes). In its derivation it is a shoot in which the stem is short, while the leaves have undergone more or less modification for special reproductive purposes. Thus there are usually one or more whorls of green or colored leaves (the *perianth*), which may often be distinguished into an outer whorl (the *calyx*, composed of *sepals* commonly of a green color) and an inner whorl (the *corolla*, composed of *petals*, commonly white, red, yellow, blue, etc.). Within or above the calyx and corolla are found one or more whorls of slender pollen-bearing leaves (the *stamens*), and within or above these one or more seed-bearing leaves (the *pistils*). In the simpler flowers these parts are all present in the order given, and are separate from one another (Fig. 1, A). There are, however, many modifications of this simple type. On the one hand, the parts become more and more united (Fig. 1, B to F), while at the same time they may become more irregular as to size and shape, and every part may exhibit a wide departure in size, shape, and texture from the original type. On the other hand, there have been considerable modifications, by the omission of one or more parts, sometimes resulting in a reduction to a single organ, as in the willows, where some flowers have been reduced to a pistil only.

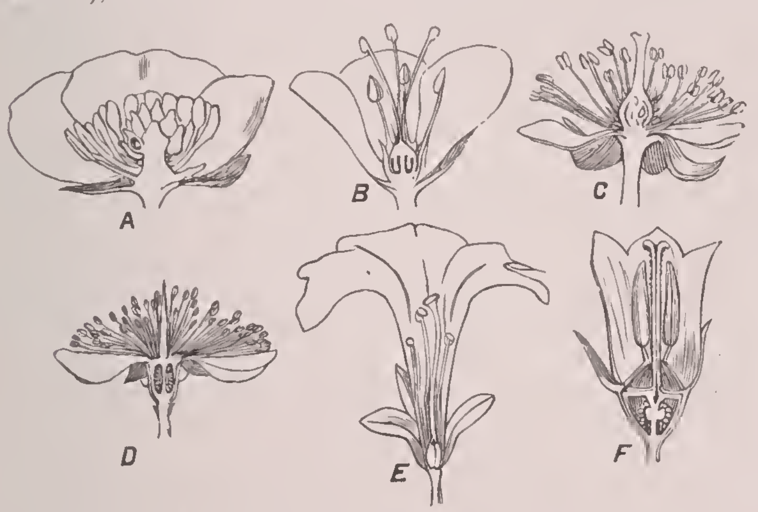


Fig. 1.—A, crowfoot; B, flax; C, linden; D, myrtle; E, petunia; F, bellwort.

In the stamen two parts can generally be distinguished—viz., the stalk (called the *filament*), and the pollen-sacs (*anthers*) at its summit. The anther is usually two-celled (sometimes one-celled), and at maturity contains a quantity of minute rounded cells, the *pollen*.

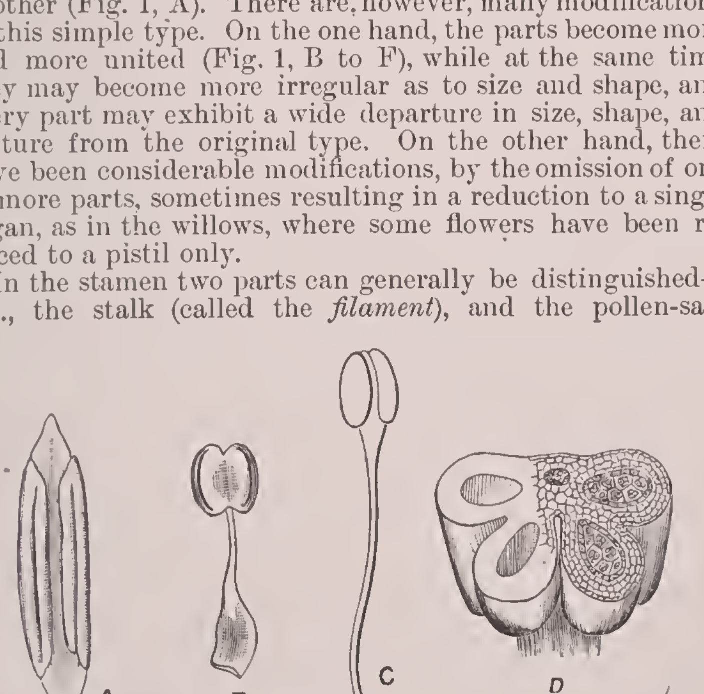


Fig. 2.—A, stamen of magnolia; B, aconite; C, anemone; D, cross-section of a young anther.

The pistil generally consists of three parts—viz., the lower, enlarged part, the *ovary*, containing the young seeds (*ovules*), a slender and often elongated stalk-like projection (*style*) usually from the upper part of the ovary, which bears the *stigma* upon its summit (Fig. 3). The pistil is a folded leaf, with the ovules normally growing from its margins. When two or more pistils grow together, the result is a compound pistil (Fig. 3, B).

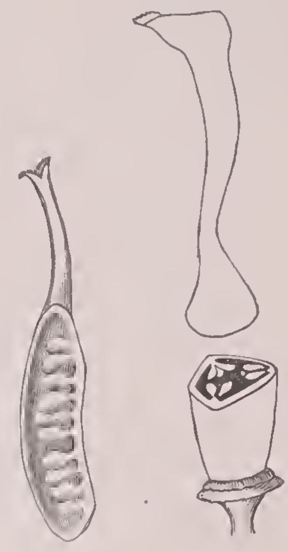


Fig. 3.—A, longitudinal section of a simple pistil of aconite; B, cross-section of a compound pistil of violet.

The purpose of the flower in the economy of the plant is the production of new plants, or, what amounts to the same thing, the production of perfect seeds. Every detail as to form, color, odor, honey-secretion, etc., has to do with this prime object. While the only parts which are directly engaged in the production of new plants are the stamens and pistils, yet the part played by the petals and sepals is often of equal importance. In order that a new plant may be produced, the protoplasmic contents of a pollen-cell must unite with an egg-cell in the ovule. This can be accomplished only when the pollen-cell has been placed upon the stigma, where it is able to germinate into a long tube which, penetrating the style, finally reaches the egg-cell of the ovule where the two protoplasms unite. See Embryology (in plants), and Physiology (of plants). The placing of the pollen upon the stigma (pollination) is thus a matter of the greatest importance, and accordingly flowers have many devices intended to insure its performance. Not only is pollination all-important, but it is almost equally necessary that it should be done in a particular way; thus it is usually better that the pollen should come from another plant, or at least from another flower, than from the same plant or the same flower. To tell how the winds, insects, and birds are made the agents for carrying the pollen from flower to flower; how color, odor, and honey serve as baits or lures; how special forms of calyx, corolla, stamens, and pistils, all take part in this work, would exceed the limits of this article.

For a full discussion of this subject, the reader is referred to Charles Darwin's *The Various Contrivances by which Orchids are Fertilized by Insects*; *Different Forms of Flowers on Plants of the Same Species*; *Effects of Cross and Self-Fertilization in the Vegetable Kingdom*; Asa Gray's *How Plants Behave*; and Hermann Müller's *Fertilization of Flowers* (which includes a list of 825 papers and books treating of pollination). See also Embryology (in plants) and Flowers, Colors of. Charles E. Bessey.

Flower, Roswell Pettibone, LL. D.: banker; b. in Theresa, Jefferson co., N. Y., Aug. 7, 1835. In early life he worked on a farm, in a brick-yard, and in a country store; after taking a course in the Theresa high school became a teacher; engaged in the jewelry and brokerage business in Watertown, N. Y.; and since 1869 had been in the banking business in New York city. He was elected to Congress, to fill the unexpired term of Levi P. Morton, resigned to become U. S. minister to France in 1881; was re-elected for a full term in 1882; was a Democratic candidate for the nomination for Governor of New York in 1882; declined the nomination for Lieutenant-Governor in 1885; was appointed one of the electric subway commissioners of New York city in 1886; was re-elected to Congress in 1888 and 1890; and was elected Governor in 1891. He received the degree of LL. D. from St. Lawrence University in 1893. D. in Eastport, Long Island, May 12, 1899.

Flower, Sir William Henry, K. C. B., F. R. S., D. C. L.: anatomist; b. at Stratford-on-Avon, England, Nov. 30, 1831; educated at University College, London; assistant surgeon Sixty-third Regiment in Crimean war 1854–55; assistant surgeon and Demonstrator of Anatomy, Middlesex Hospital, London, 1858–61; conservator of the Museum of the Royal College of Surgeons of England 1861-86; Hunterian Professor of Comparative Anatomy and Physiology 1870–86; president of the section of anatomy at the International Medical Congress held in London in 1881; president of the Anthropological Society 1883–85; director of the natural history departments of the British Museum since 1885; president of the Zoölogical Society of London since 1879; president of the British Association for the Advancement of Science 1889; president of the Museums Association. Author of *Diagrams of the Nerves of the Human Body* (1861; 2d ed. 1872); *Introduction to the Osteology of Mammalia* (3d ed. 1885); *Fashion in Deformity* (1881); *Introduction to the Study of Mammals, Living and Extinct* (with R. Lydekker, 1891); *The Horse, a Study in Natural History* (1892); *Catalogue of the Osteological Specimens in the Museum of the Royal College of Surgeons* (1886); and numerous memoirs and lectures on anatomical, zoölogical, and anthropological subjects in the transactions of various societies and journals. D. in London, July 2, 1899. C. H. THURBER.

Flower de Luce: See FLEUR DE LIS.

Flowers, Artificial: imitations of natural flowers and foliage formed from various materials, and used for personal adornment or for decorative purposes. This art or branch of manufacture is of very old date. Flowers and leaves of painted linen have been found in tombs at Thebes, and the Egyptians also invented flowers of horn shavings stained in various colors. The Chinese have made artificial flowers of the pith of a kind of bamboo from very remote times. Crassus was the first in Rome who had them made of real gold and silver. During the Middle Ages they were much used, not only in the Roman Catholic Church and with a symbolical signification, but also at secular festivals and merely as ornaments. They were generally made of paper, satin, silk, metal, and wax, and the most celebrated were made in Italy. But in 1728 Seguin, a botanist and chemist, began the manufacture in Paris, employing parchment for the flowers and bristles of the wild-boar for the stems, and his imitations were so successful as to arouse the jealousy of the painters. From this time the manufacture steadily increased and developed in France, which still stands at the head of this kind of industry. The French wholesale houses engaged in this business have each some special branch. Thus one makes only roses; another, wild flowers; a third, leaves. The work-people earn from two to six francs a day according to their skill. Of the money received by the Parisian manufacturers, three-fifths are paid to the work-people, one-fifth covers incidental expenses, and one-fifth defrays the whole cost of materials. Artificial flower-making was introduced into Great Britain during the French Revolution of 1790 by refugees, who employed the art as a means of subsistence.

The principal tools used by artificial florists are *stamps*, a kind of knives of various sizes and shapes, by means of which leaves and petals are cut out very rapidly. The material to be shaped is laid, folded several times, upon a leaden table, and the stamp is driven through it with a hammer. This part of the work is done by men. Stamps (or, as they are often called, *irons*) were invented in Switzerland at the beginning of the eighteenth century. Leaves and petals had previously been cut out with scissors. *Goffering-irons* of different kinds, the commonest being a ball of polished iron fastened to a handle, are used to hollow the petals. *Molds* called *veiners* are, as the name indicates, employed to vein the leaves. *Burnishers* of glass or agate give the petals the polished appearance of most real flowers. Many other tools exist, but their use has greatly diminished. The florist's fingers, guided by skill and taste, are found better than any mechanical appliance. The best flowers are carefully painted by hand. Harvard University possesses a unique collection of flowers, made entirely of glass, illustrating chiefly the flora of the U. S. See *Dictionnaire Universel du XIX^e Siècle*, Larousse, art. *Fleurs Artificielles*, and *Art of Making Paper Flowers*, by Mrs. Bartlett (New York).

Flowers, Colors of: although the coloring principles contained in many of the most important vegetable dyestuffs have been isolated and their composition and chemical relations clearly established, as in the case of madder-root, Brazil-wood, logwood, quercitron bark, indigo, weld, archil, etc., and some of them, as the alizarin of madder, have been produced artificially, the colors of flowers have, with few exceptions, thus far resisted all attempts at isolation. This is perhaps partly owing to their fleeting character and the changes which they so readily undergo. The colors of flowers often change spontaneously during the life of the flower. The flowers of *Myosotis versicolor*, the common garden weed forget-me-not, open with a yellow tint, but soon change to blue. The *Cheiranthus mutabilis* opens yellow, then changes to orange, red, and finally to purple. Some flowers even change color during the day. Garden phlox is blue in the early morning and pink in the middle of the day. *Hibiscus variabilis*, which is white in the morning, is pink at noon and bright red toward night. The colors of flowers are very sensitive to chemical reagents. The petals of the purple or violet dahlia are reddened by acids, the purple being restored by alkalies, but changed to green by an excess of alkali; a red rose is bleached by sulphurous acid, but the color is restored by dilute sulphuric acid.

Many flowers contain more than one coloring-matter. The petals of the safflower yield a yellow color to water and a red principle to alkalies. The orange-colored *Tropæolum majus* yield a purple coloring-matter to boiling water, becoming yellow; boiling alcohol then extracts a purple substance. When the purple is absent the flowers are yellow; when present they exhibit various shades of brown. The flowers of the brown *Calceolaria* yield two similar colors under like treatment.

In but few cases have the coloring-matters of flowers been isolated and their nature determined with any certainty. The coloring-matter of the saffron crocus (*Crocus sativus*) has been isolated, though not in a pure state. It is known as *polychroite*, and is supposed by Roehleder to be identical with *crocin*, $C_{58}H_{86}O_{31}$, the coloring principle of Chinese yellow berries. (See SAFFRON.) The red coloring principle of the safflower (*Carthamus tinctorius*) is a very important dye. (See SAFFLOWER.) It is called *carthamin*, $C_{14}H_{16}O_7$. The blue and red pigments of flowers are generally soluble in water, while the yellow matters are often resinous, and dissolve only in alcohol and ether. They are generally very fugitive, and consequently of little value in dyeing.

Floy, JAMES, D. D.: preacher and author; b. in New York, Aug. 20, 1806; studied for a time in Columbia College and afterward in London; became a preacher in the Methodist Episcopal Church in 1833; preached in New York, Brooklyn, N. Y., New Haven, Conn., etc.; edited *The National Magazine* and *Good News*; edited the works of Stephen Olin, and served on the "committee on versions" of the American Bible Society. *Old Testament Characters*, *Guide to the Orchard and Fruit-garden*, etc., were from his pen. He was prominent as an anti-slavery leader. D. in New York, Oct. 14, 1863.

Floyd, JOHN: U. S. general; b. in Beaufort, S. C., Oct. 3, 1769; removed to Georgia in 1791; was brigadier-general of the Georgia militia Aug., 1813, to Mar., 1814; commanded at the battle with the Creek Indians at Autossee, Ala., Nov. 29, 1813, and at the battle at Camp Defiance, Ala., Jan. 27, 1814. Was often in the State Legislature; M. C. in 1827–29; and also major-general of the State militia. D. in Camden co., Ga., June 24, 1839.

Floyd, JOHN BUCHANAN: statesman and soldier; b. in Montgomery (now Pulaski) co., Va., 1805; graduated at South Carolina College 1826; studied and practiced law; removed to Helena, Ark., 1836, returning to Virginia in 1839; member of Congress from Washington co., Va., 1847–49; Governor of Virginia 1850–53; took an active part in favor of the nomination and election of James Buchanan as President, by whom he was appointed Secretary of War Mar., 1857. During his term of office he used his power in dispersing the U. S. army to distant and not easily accessible parts of the country, in transferring arms and ammunition to Southern arsenals, and generally in preparing for the conflict which it now appears he must have been aware was impending between the North and the South. On the secession of South Carolina he became a zealous sympathizer with the secession movement, opposed the reenforcement of the forts and troops in Charleston Harbor, and upon President Buchanan's refusing to withdraw the U. S. forces from that harbor resigned his office. He was indicted by the grand jury of the District of Columbia as being privy to the withdrawal of a large amount of bonds from the Department of the Interior, but having left Washington was never brought to trial. Was appointed brigadier-general in the Confederate army, and commanded in 1861 in Western Virginia. His operations there were unsuccessful, and severely commented upon by the Virginia press. He was subsequently transferred to Kentucky, and at Fort Donelson commanded a brigade, being senior officer, but abdicated his command and withdrew, the night previous to the surrender, with Gen. Pillow and some 5,000 men. He afterward held several unimportant commands. D. at Abingdon, Va., Aug. 26, 1863.

Floyd, William: b. in Brookhaven, Suffolk co., L. I., Dec. 17, 1734; was in the Continental Congress 1774-83, and signed the Declaration of Independence; was again in Congress 1789-91; was a presidential elector 1800, 1804, 1820, and was a prominent State legislator. He served actively in the Revolutionary war 1775-83, in which he lost much property. At the close of the war he was appointed major-general of militia. In 1803 he removed to Weston, Oneida co., N. Y., where he died Aug. 4, 1821.

Floyer, Sir John: physician; b. at Hinters, in Staffordshire, England, in 1649. He studied medicine at Oxford, and practiced as a physician at Lichfield. It was he who sent Dr. Johnson, when a child, to be touched by Queen Anne for the king's evil (1714), and he was the author of a number of more or less curious writings, including *The Sibylline Oracles, Translated from the Best Greek Copies and Compared with the Sacred Prophecies* (1713). D. at Lichfield, Feb. 1, 1734. Dr. Johnson speaks highly of his learning and piety.

Fludd, Robert (in Lat. *Robertus de Fluctibus*), "The Searcher": an English Rosicrucian and alchemist; b. at Bearstead, Kent, in 1574; entered St. John's College, Oxford, in 1591; studied five years on the Continent; took his medical degree at Oxford 1605. He was a famous physician, and the author of numerous obscure Latin works, theosophical, philosophical, and mathematical, but his enigmatical style prevents the intelligent study of his works. His doctrine was a refined dualism; his writings have only an historic value. Kepler, Gassendi, and P. Mersenne were his adversaries. D. in London, Sept. 8, 1637.

Flüe, flü'e, Niklaus, von, generally known under the name of **Brother Klaus**: patriot and hermit; b. at Flüeli, in the canton of Unterwalden, Switzerland, Mar. 21, 1417. He was a man of great practical energy and ability, the father of a household consisting of ten children, and he took active part in the business of the community to which he belonged. But the deepest instinct of his nature was asceticism, and on Oct. 16, 1467, he retired to a lonesome place among the Alps, where he built a cell and spent the rest of his life as a hermit. Thousands of pilgrims visited him; miraculous powers were ascribed to him, and for twenty years he exercised a wide influence by his exhortations and warnings. At the diet of Stans (1481) he saved the confederation from civil war, and brought about an agreement which formed the foundation of the Swiss constitution for 300 years. D. in his hermit's cell at Ranft, near his native place, Mar. 21, 1487. After his death his countrymen made great exertions to have him canonized, but in spite of subscriptions, heavy taxes, etc., it proved impossible to raise the sum which Clement IX. demanded for a canonization; the canton of Unterwalden had to content itself with a beatification. See his *Life* by J. Ming (Lucerne, 3 vols., 1861-71).

Flue: See Chimney.

Flüelen, flü'e-len, or **Flühlen**, flü'len: village of Switzerland; in the canton of Uri; on the southern arm of Lake Lucerne; 2 miles N. of Altorf (see map of Switzerland, ref. 4-G). Here is a chapel which was erected in 1388 to the memory of William Tell, and is annually visited by a large number of persons in Ascension week. According to one version of the old Swiss legend, the chapel is situated on the very spot where William Tell jumped to the shore, thrusting the boat, with the crew and Gessler, back into the surf. There are, however, as is well known, other points along the shore for which the same claim is made, and, as it would seem, on equally good authority.

Fluents: See Fluxions.

Flü'gel, Gustav Lebrecht: Orientalist; b. at Bautzen, Germany, Feb. 18, 1802; educated at Leipzig; became the pupil in 1827 of Von Hammar at Vienna. The *Arabic Anthology of Thâalibi* (fugitive poetry), published in 1829, led to his appointment on a scientific mission by the Austrian Government, and for three years he traveled in Hungary, Styria, parts of Germany, and in France. Became professor in the College of Meissen in 1832; resigned 1850; published his *History of the Arabs* in 1833, and an edition of the Koran, and subsequently a concordance of the Koran. In 1835-54 appeared, at the expense of the London Oriental Society, his Latin translation of *The Encyclopædia and Biographic Dictionary of Hadschi-Chalfa*, with commentary. He wrote also *Mani und Seine Lehre* (1862), published Arabic, Turkish, and Persian MSS., and other works. D. at Dresden, July 5, 1870.

Flügel, Johann Gottfried: lexicographer; b. at Barby on the Elbe, Germany, 15 miles from Magdeburg, Nov. 22, 1788; spent ten years in the U. S. (1810-19); was Professor of the English Language in the University of Leipzig 1824-38, when he was appointed U. S. consul at Leipzig, where he died June 24, 1855. He published, besides other works, a *Merchants' Dictionary, in German, English, and French* (3 vols., 1840; 2d ed. 1854), but is best known by his *Complete English-German and German-English Dictionary* (2 vols., 1830), in the last edition of which (1852) he was assisted by his son, Dr. Felix Flügel.

Fluidity: See Fluids.

Fluids [from Fr. *fluide*: Ital. *fluido*, representing Lat. *flu'idus*, fluid, flowing, deriv. of *flu'ere*, flow]: substances in which there is an entire absence of any tendency to resist change of form (in the case of liquids) or change of form or volume (in the case of gases) under the action of applied forces, which characteristic is called fluidity.

Liquids are frequently called "incompressible fluids," but a better criterion by means of which to distinguish a liquid from a gas is the presence of "surface tension" and a surface film.

In point of fact the gaseous and liquid forms approach each other by insensible gradations as a certain critical temperature and pressure are approached (differing widely with the substance experimented upon), until finally they become identical.

A similar continuity of solid and liquid states has been observed under conditions less easily attained. See Carl Barus, *Am. Jour. Science*, vol. xli., p. 325.

The properties of matter in all three states, as regards the effects of forces in producing change of forms, vary widely according to the suddenness of application.

Thus solids, generally rigid, show themselves plastic under the action of forces gradually applied, changing form without rupture. Liquids and even gases, on the other hand, when subjected to sufficiently sudden stress exhibit a property closely allied to rigidity of form. See Gas, Hydrodynamics, and Hydrostatics. E. L. Nichols.

Flukeworms: a common name applied to different members of the Trematode genus *Distomum*, and more especially to the liver fluke (*Distomum hepaticum*) of the sheep. They are, as a rule, flat and oval, smooth, soft, and not jointed, and are mostly hermaphrodite, having sexual organs which constitute a large part of the organism. They pass through the following history: The eggs are laid in the liver, and pass with the gall to the intestine and thence to the exterior. They hatch on the wet grass, producing a small larva which bores into the body of the snail *Lymnæa*. Here it secretes a capsule, and the contents of this break up into so-called spores. These develop into a worm-like embryo, the so-called redia, which possesses a mouth. Inside of the redia are developed other redia, as well as a new tadpole-like larva, the cercaria. These latter escape from the snails, and, crawling about on the grass, are eaten by the sheep. Inside the stomach they are set free from a new capsule they have secreted, and then they bore their way through the tissue to the liver, where they become sexually mature. As will be seen, there is here an alternation of one sexual with two asexual generations, as well as a change in hosts. The presence of these parasites in the liver causes the disease commonly known as "sheep-rot" and "liver-rot," which, fortunately, is rare in the U. S. In 1879-80 it caused the death of over 3,000,000 sheep in the British kingdom. Several varieties of fluke infest the biliary passages in man, especially in Japan. Another form is found in the blood of man and causes hæmaturia. (See Hæmatozoa.) In Japan and China a form of Distoma is found which infests the bronchial tubes, and leads to hæmorrhage from the lungs and chronic cough. For allied forms, see the article Trematoda. J. S. Kingsley.

Flume, The: a cleft between two walls of rock in the Franconia Mountains; in the town of Lincoln, Grafton co., N. H. A small stream flows through it and just below falls over 600 feet in a cascade. The Flume is a favorite resort of tourists in the White Mountain region.

Fluohy'dric (or **Hydrofluor'ic**) **Acid** [derived from *fluorine* and *hydrogen*]: See Fluorine.

Fluor: a less common name of Fluor Spar (*q. v.*).

Fluoresceïn, floo-ō-res'sē-in: See the article PHTHALIC ACID.

Fluorescence [deriv. of Eng. *fluor*, fluorite or fluor-spar, of which fluorescence is a notable property; *fluor* is originally a Lat. word meaning a flowing, flux, applied to fluorite on account of its use as a flux]: an action of certain substances upon light by which they absorb light-energy of shorter period or wave-length and re-emit it in waves of greater length, thus under certain conditions appearing self-luminous with brilliant and various colors.

The simplest and most striking illustration of this action is the following:

On the surface of water in a clear-glass jar let fall a few particles of the coal-tar color known as fluoresceïn. As the particles of this brick-red powder slowly dissolve, root-like filaments of intense green color will descend into the water, soon producing the appearance of a bunch of delicate seaweed. If the vessel is placed between the eye and the source of light, however, these opaque green filaments will appear perfectly transparent and of a reddish-orange color. The reason of these appearances is that the light of shorter wavelength (i. e. the blue and violet and even invisible rays) is absorbed by the solution and re-emitted in longer waves constituting green light, while the light which passes through this solution, being deprived of these shorter waves, has a resultant or residual color-effect of reddish orange.

A few other substances like the above possess this property in such a high degree that it can be exhited in the same simple manner; but there are a great number which require some special arrangement to make it manifest.

One of the simplest of such arrangements is to provide a pencil of light in a dark room, consisting solely of the very short rays, including the blue and violet and yet higher invisible rays of the spectrum. This may be done by reflecting sun-rays into a dark room by means of a "porte lumière," and then passing them through a glass tank filled with a solution of ammonio-sulphate of copper. A large number of substances placed in the path of the faintly visible purple-blue light thus obtained will glow as if on fire, with their peculiar tints. Thus a block or a vessel made of "canary glass" will glow as if it were made of self-luminous emerald; an acid solution of quinine sulphate will gleam with vivid sky-blue; a solution of "chlorophyl" (the green coloring-matter of plants) will show blood-red.

The light of burning magnesium or of the electric arc, similarly filtered through the same solution or through sheets of cobalt glass, will act in like manner. By these means very striking illustrations of fluorescence may be made on the large scale.

A substance, thallene, discovered by the writer (London *Chem. News*, 1872, vol. xxvi., p. 273), especially lends itself to such use. On various occasions screens 20 feet square, made of orange-colored muslin on which were attached designs in paper, coated with thallene, have been used in the largest auditoriums. Illuminated by light from burning magnesium or an electric arc inclosed in a box with a sheet of cobalt glass, such a screen appears as though made of black velvet with designs of self-luminous and vivid color upon it.

Another means of exhibiting fluorescence is furnished by the electric discharge through rarefied gases, which produces light rich in waves of small length. This is availed of in many of the structures known as "Geissler tubes." In these, portions of the tubes through which the electric discharge takes place are made of "canary glass," or are surrounded by jackets of glass which may be filled with fluorescent solutions. When the electric discharge, from an induction coil or from a Holtz machine, is passed through these, we have, in addition to the variously colored light produced by the discharge itself, a great variety of luminous colors, due to the fluorescence of the glass and of the solutions in the jackets.

Fluorescent actions are also developed in many of the experiments made by Dr. William Crookes where he employed the electric discharges from an induction coil in high vacua.

Having thus considered the more obvious and familiar phenomena of fluorescence, we may next take up the history of its discovery and investigation, which will involve some reference to more recondite actions.

The first recorded observation of a definitely fluorescent action is found in the Edinburgh *Philosophical Transactions* for 1833, vol. xii., p. 542, where Sir David Brewster describes some phenomena which are now recognized as belonging to this subject. In volume xvi. of the same journal he describes other appearances, as also in the *Philosophical Magazine*, vol. xxxii., p. 401, 1848. In 1845 Sir John Herschel described the luminous appearance of some solutions of quinine, under the name of "superficial color," or "epipolic diffusion." In none of these papers, however, was the true nature of the action recognized.

In the *Philosophical Transactions* for 1852, part ii., p. 466, appeared a paper by Prof. G. G. Stokes, F. R. S., occupying more than 100 pages, pointing out the true nature and relations of this remarkable action, to which he gave the name fluorescence, because he first observed and studied it in the mineral fluor spar, which possessed this property in a marked degree, although vastly less than other bodies more recently discovered. This research of Prof. Stokes was a model for thoroughness and accuracy, and exhausted the subject as far as the materials and means of research known at that date were concerned.

In 1850 Edmond Becquerel published in the *Annales de Chimie et de Physique*, 3d series, vol. lvii., p. 101, an investigation of a number of substances which he designated as "phosphorescent"; but nearly all of them are the same or similar to those studied by Stokes, and the actions with a few exceptions are simply those of fluorescence, as recognized and defined by Stokes. In his extensive work entitled *La Lumière*, published in 1867–68, Becquerel devotes over 200 pages to the same subject. In the *Comptes Rendus* of Aug. 3, 1872, Becquerel published an abstract of a research on what should be called the fluorescent properties of certain uranic salts, and in the *Ann. de Chim. et de Phys.*, 4th series, vol. xxvii., 539–579, of the same year, the entire memoir. Hagenbach, in the *Ann. Phys. und Chim.*, 1872, vol. cxlvi., pp. 65, 232, 375, and 508, has discussed the fluorescent properties of a great number of substances. (See also *Journal of London Chem. Society*, 2d series, vol. x., p. 1058, and *Lond. Chem. News*, vol. xxvi., p. 173.) He has also published many other papers on the same subject in more recent columns of the *Ann. Phys. und Chim.* Eugen Lommel has also published many papers in the last-named journal, as in vol. cxliii., p. 26, 1871; vol. clix., p. 514, 1876; and new series, vol. x., pp. 449 and 631, 1880.

The writer of this article has also made a number of investigations on the spectra of the fluorescent light emitted by the salts of uranium and by certain products obtained in the destructive distillation of petroleum, and others like them, and also on the absorption spectra of the same substances. These were published during the years 1872–74 in the London *Chemical News*, the American *Chemist*, the *Moniteur Scientifique*, the London *Philosophical Magazine*, and Poggendorff's *Annalen*.

In addition to pointing out the true nature of the fluorescent action, Stokes announced the law (since known by his name) that the wave-length of the light emitted by a fluorescent body was always greater than that of the existing light. This law has been called in question in a few instances by Lommel and some others, but the objections have been met by Hagenbach in what appears to be a satisfactory manner. From this law or mode of action flow curious consequences. Thus light waves too short to affect the eye under ordinary conditions (such as the supra-violet rays of the solar spectrum) falling on a fluorescent body may develop in it visible rays. Thus Stokes, by throwing a solar spectrum on a screen of turmeric paper, canary glass, etc., was able to trace its upper end far beyond the H. H. lines, which are its ordinary visible limit, and to map out many lines in this upper portion otherwise only recognizable by photography. Considerable development was given to this subject later by Stokes (*Phil. Trans.*, 1862, ii., p. 599), when with the light of the electric spark and quartz prisms he produced, on fluorescent screens, spectra five times as long as the ordinary solar spectrum. Again Stokes pointed out that there were usually certain wave-lengths in the exciting light which had greater effect in exciting fluorescence than others. Thus if a solar spectrum is thrown on a screen or surface of fluorescent material, the latter will not be made to emit fluorescent light equally under all parts of the spectrum, but will show bands of maximum brightness which will vary in number and position with the fluorescent substance acted on. Also, as might naturally be expected, those wave-lengths of the exciting light which most powerfully excited fluorescence are the most rapidly absorbed by the fluorescent substance, so that if the light transmitted through such a body is examined by the spectroscope absorption bands or dark spaces will be seen, corresponding in position with the maxima of fluorescence.

Both these actions are well illustrated by applying one of Stokes's methods of observation to a solution of "thallene," a hydrocarbon discovered by the present writer (*Chem. News*, 1876, vol. xxxiv., p. 188). For this purpose a pure solar spectrum is thrown against the vertical side of a square tank containing the solution. This side of the tank is best made of quartz, which has no fluorescence of its own, but in most cases ordinary thin plate-glass will serve very well.

Fig. 1 represents the appearance of such a tank, seen from above and filled to the depth of an inch with the solution named.

The scale and letters below the figure indicate the parts of the spectrum falling on the vertical side or face of the tank.

The green part of the spectrum from E to *b* and beyond excites a faint fluorescent light in the solution, then come rays which have no effect until, at F and above, a powerful fluorescence is excited, giving the bright blade *b* which reaches far into the tank. Then comes a space of no action and again one of maximum effect, producing the blade *c*. Then again a space of no action, until at *G* suddenly begins another maximum gradually fading out to the right.

Looking at the opposite side of the tank, it will be observed that dark blades are located exactly over against the maxima of absorption, and indicate that, looking into the tank from that side, we should see dark bands or spaces corresponding with the maxima of fluorescence on the other side of the tank.

Again, Stokes showed that the fluorescent light, or light emitted by the fluorescent substance, was in many cases composed of a few groups of wave-lengths, so that when viewed through a prism it would exhibit a spectrum made up of bright-colored bands with dark spaces between them. This effect is exhibited in the most decided and beautiful

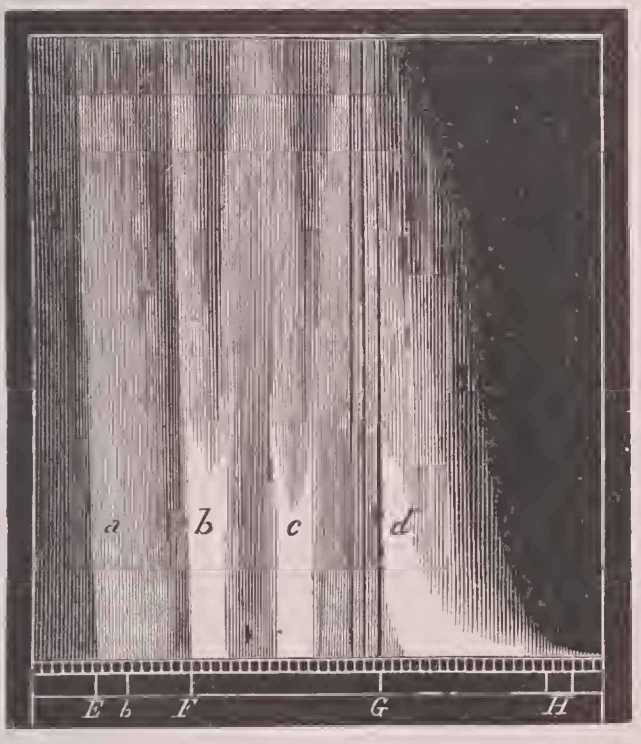


Fig. 1.—Thallene in benzole.

degree by the salts of uranium, and its study has enabled the present writer to discover and distinguish a number of new compounds whose existence would otherwise have been quite unsuspected. For example, if some crystals of the ammonio-uranic sulphate are placed in the path of a pencil of sunlight, concentrated by a lens and deprived of its less refrangible or longer waves by passing through a layer of ammonio-sulphate of copper in a glass tank about a quarter of an inch thick, and the fluorescent light which they emit is examined through a spectroscope, the appearance presented will be that shown in Fig. 2, stripe 1.

There will then be seen a banded spectrum having a band of bright red at C, orange-red at 4, orange between 4 and D, then yellow, yellow-green, blue-green, and blue in the succeeding bands up to F, at the right. The upper edges of all these bands, except the last to the right, are sharply defined, but they shade off gradually on their lower or left-hand edges. If these crystals are gently heated, so as to expel some water, their spectrum will change to that shown in the sec-

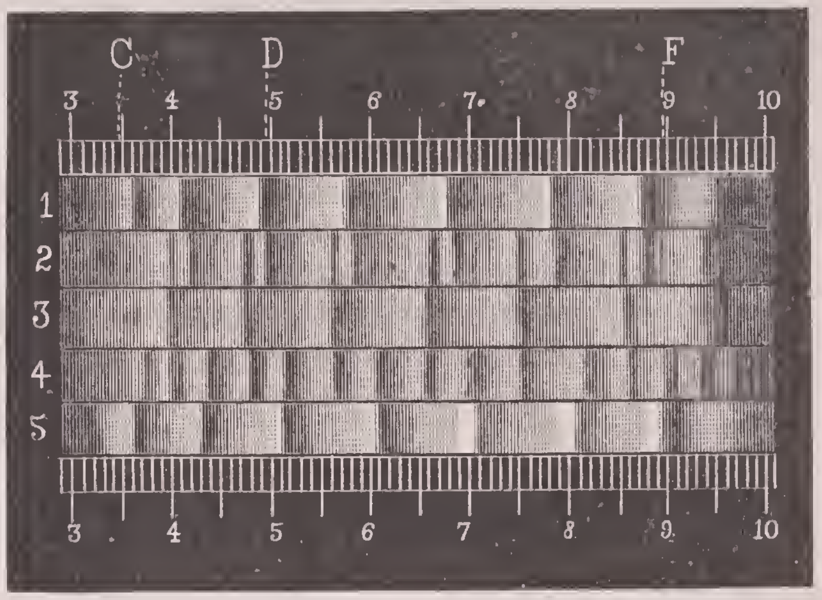


Fig. 2.

ond stripe of Fig. 2, in which it will be noticed that the same spectrum as before is obtained, but with another set of bands superposed or added. If the heating is continued, the first spectrum will grow weaker and the new one stronger, until at last the new one only is left, as is shown in stripe 3 of Fig. 2; after this the same heating will produce no further change.

If, however, the heat is greatly increased, another new spectrum shows itself in combination with the last, as is shown in stripe 4, and by continuing this heat the spectrum shown in stripe 5 remains alone. Analysis shows that the salt whose spectrum appears at 3 is the anhydrous ammonio-

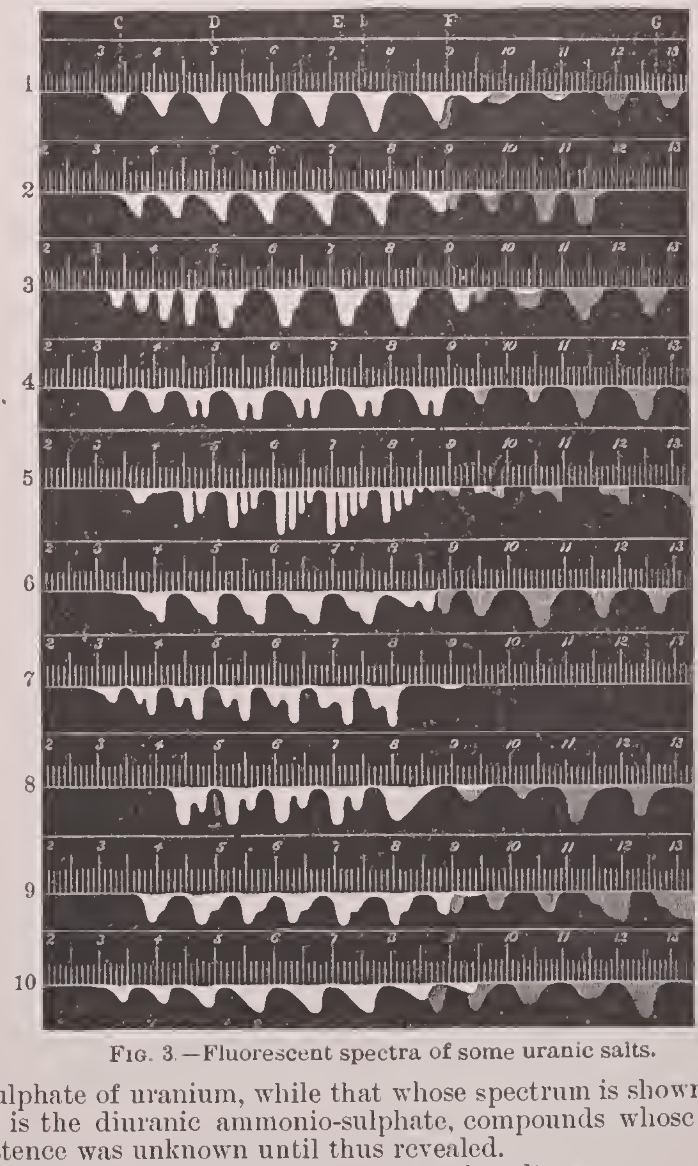


Fig. 3.—Fluorescent spectra of some uranic salts.

sulphate of uranium, while that whose spectrum is shown at 5 is the diuranic ammonio-sulphate, compounds whose existence was unknown until thus revealed.

The fluorescent spectra of the uranic salts are very various and often very beautiful. Fig. 3 is a diagram illustrating a few of them. In this diagram the location of the various bands is indicated by the position of the white spaces in reference to the Bunsen spectroscope scale and the Fraunhoffer lines indicated by their letters.

The depths of the white spaces below the lines indicate their relative brightness, or, in other words, the way in which they shade off, or terminate more or less abruptly. The salts whose spectra are indicated in this chart are the following: No. 1, nitrate of uranium; No. 2, acetate of uranium; No. 3, sodio-acetate of uranium; No. 4, oxychlorides of uranium (mixed); No. 5, potassio-oxychloride of uranium; No. 6, oxyfluoride of uranium; No. 7, bario-oxyfluoride of uranium; No. 8, phosphate of uranium (mixed hydrates); No. 9, calcio-phosphate of uranium; No. 10, ammonio-sulphate of uranium.

The shaded spaces to the right indicate absorption bands not directly concerned in the present subject.

The spectra of more than eighty such salts of uranium have been mapped and studied, and will be found in articles by the present writer in the London *Chemical News* of 1873.

In certain cases, as in that of the double acetates of uranium, there are many salts exactly alike in general constitution, one constituent being acetate of uranium in each case, and the other being the acetate of some other base, as sodium, potassium, lithium, etc. When the fluorescent spectra of these salts are studied it is found that they are all exactly alike as to the number and form of their bands, but that the entire sets of bands are shifted up or down in the spectrum in the several salts. If these salts are now tabulated according to the positions of these bands, the highest being placed first, it will be found that their order is exactly that of their molecular weights. In fact, they act precisely as though the rates of vibration due to the acetate of uranium, which is their only *fluorescent* constituent, were reduced by the "loading" effect of the other acetates in proportion to *their* molecular weights. This is precisely like what would happen if to a series of tuning-forks increasing weights were added from time to time. When a slight weight was added to each, their "pitch" would be a little lowered, and more and more so as the weights were increased.

In all fluorescent liquids and some solids the duration of the fluorescent emission after the exciting light is cut off is inappreciable, but in most solids it has a finite duration varying from a thousandth of a second in some to many minutes in others.

This persistent fluorescence is sometimes distinguished as phosphorescence, and was first systematically studied by Becquerel, and described in the works referred to earlier in this article.

In 1888 E. Wiedemann showed that this prolongation of the fluorescent action could be given to some solutions by solidifying them by combination with gelatin. *Ann. Phys. und Chem.*, new series, vol. xxxiv, p. 446.

To give anything like a complete list of all fluorescent substances would occupy much more space than can be devoted to the present subject, but it will be of interest and value to name a few of those most important in the history of the subject or by reason of their exceptional intensity.

SOLID FLUORESCENT SUBSTANCES.—*Fluor Spar* (fluoride of calcium).—Certain varieties. Fluorescence blue, moderately brilliant. Chiefly of interest because observed by Herschel and Brewster at an early period, and made the basis of the name given to this action by Stokes. *Phil. Trans.*, 1852, part ii., p. 481.

Platino-cyanide of Barium.—This salt in a certain state of hydration and aggregation has a very remarkable power of fluorescence, so that if words or figures are written or drawn on paper of an orange tint with a mixture of this salt and gum-water, and then are viewed in daylight transmitted through cobalt glass, they will shine out with a brilliant green light on the almost black ground furnished by the orange paper, illuminated by the violet-blue light.

Thallene.—A hydrocarbon obtained from the products of the destructive distillation of petroleum. (*Journal of the Franklin Institute*, Philadelphia, 1876, vol. lxxii., p. 225.) This fluoresces with an even more brilliant green light than the foregoing under like conditions.

Canary Glass.—Glass colored of a yellow tint with oxide of uranium. This fluoresces with a brilliant green tint, and is much used in Geissler tubes.

Fluorescent Solutions.—As possessing historic interest because studied by the early investigators may be mentioned:

Solutions in water of quinine acidulated with any acid except hydrochloric. Fluorescence sky-blue. Stokes, *Phil. Trans.*, 1852, ii., pp. 471 and 541.

Solutions in water (alkaline or neutral) of æsculin, from horse-chestnut bark. Violet-blue fluorescence.

Solution in alcohol of chlorophyll, the green coloring-matter of leaves. Fluorescence blood-red.

Solution in alcohol of bichloranthracene. Fluorescence purple-blue.

Solution in water or alcohol of extract of stramonium seeds. Fluorescence green.

Of more recent discovery and remarkable brilliance:

Solution in water of bisulphobichloranthracenic acid. Violet-blue fluorescence. See Perkin, London *Chem. News*, 1870, vol. xxii., p. 37.

Solution in alcohol of magdala red. Crimson fluorescence. Schiendl, *Ann. Phys. und. Chem.* (1869, vol. cxcii., p. 503); Hofmann, *Ber. d. Chem. Ges.* (vol. ii., pp. 374, 412.

Solution in water of eosin (alkaline salt of fluoresceïn). Intense grass-green fluorescence. Bayer (*Ber. d. Chem. Ges.*, 1871, vol. iv., p. 558, and 1874, vol. vii., p. 1211); Hofmann (*Ber. d. Chem. Ges.*, 1875, vol. viii., p. 62); and Bayer, same journal and volume, p. 146.

Solution in alcohol of azoresorufin. Scarlet-red fluorescence. Weselsky, *Ann. Chem. und Pharm.*, vol. clxii., p. 274.

Solution in alcohol of resorcin-blue garnet. Garnet-red fluorescence, indigo-blue by transmitted light. Brunner and Kraemer, *Ber. d. Chem. Ges.*, 1884, vol. xvii., p. 1863.

Solution in alcohol of chinolin red. Red fluorescence. Hofmann, *Ber. d. Chem. Ges.*, 1887, vol. xx., p. 4.

Iodine vapor is stated by E. Lommel to fluoresce orange-yellow, when excited by green rays about E. *Phil. Mag.*, 1883, 5th series, vol. xvi., p. 463. HENRY MORTON.

Fluoride of Aluminium and Sodium: See CRYOLITE and GLASS.

Fluoride of Calcium: See FLUOR SPAR.

Fluorine [from Mod. Lat. *fluorina*, deriv. of *fluor*, fluor spar, in which fluorine is found]: a nonmetallic element belonging to the group which includes chlorine, bromine, and iodine. It occurs abundantly in fluor spar, which is a fluoride of calcium; in cryolite (fluoride of aluminium and sodium), topaz, mica, amphibole, chondrodite, tourmaline, apatite, and numerous other minerals. It is very generally diffused, occurring in all rocks in small quantities. It is also found in almost all waters in minute quantities; in plants, especially in grasses and *Equisetaceæ*; and in animals in the bones, teeth, brain (*Horsford*), blood, urine, milk, etc. The name fluorine is derived from fluor spar, from *fluo*, to "flow," because this mineral has long been used as a flux.

As early as 1670 Schwankhardt, of Nuremberg, observed that glass could be etched by fluor spar and sulphuric acid. Scheele in 1771 referred this action to a peculiar acid liberated by the sulphuric acid. Fluorides are readily decomposed by chlorine, yielding chlorides. Fluorine is undoubtedly set free at the same time, but as it enters into combination with the material of almost every vessel that can be used to collect it, its isolation becomes a matter of great difficulty. Souyot (*Comptes Rendus*, xxii., 960) decomposed fluoride of silver by chlorine or iodine in a vessel of fluor spar, and obtained a colorless gas which did not bleach vegetable colors, but which decomposed water and attacked most metals. Frémy (*Comptes Rendus*, xxxviii., 393; xl., 966), by decomposing fused chloride of potassium by the voltaic current, obtained a gas having similar properties. He also obtained a gas which corroded glass by the action of chlorine and of oxygen, on red-hot fluor spar. H. Reinsch (*N. Jahrb. Pharm.*, xi., 1), by heating a mixture of cryolite, plumbic peroxide, and acid potassic sulphate, obtained a colorless gas consisting largely of oxygen, but containing another gas possessing a pungent odor, like that of nitrous acid, which he supposed to be fluorine. Kämmerer (*J. pr. Ch.*, lxxxv., 452), by heating iodine with fluoride of silver, obtained a colorless gas which did not attack glass, could be collected over mercury, and was rapidly absorbed by potassic hydrate. In 1886 Moissan described experiments by which he had succeeded in isolating fluorine. The method employed by him consists in passing an electric current through anhydrous hydrofluoric acid, containing a little acid potassium fluoride, HF. KF, in solution. The decomposition is effected in a vessel made of an alloy of iridium and platinum. Hydrogen is given off at the negative pole and fluorine at the positive pole.

Fluorine is a light greenish-yellow gas of a penetrating and disagreeable odor. It is the most active of all the elements at ordinary temperatures. It acts upon almost all substances. Thus it decomposes water, yielding ozone and hydrofluoric acid; it combines with hydrogen at the ordinary temperature; and it also combines with sulphur, phosphorus, iron, etc., but it does not act upon platinum. The atomic weight of fluorine is 19, its symbol F.

The detection of fluorine is effected by decomposing the supposed fluoride with sulphuric acid in a vessel of lead or platinum, and allowing the hydrofluoric acid liberated to act upon glass, which is etched or roughened by it.

Hydrofluoric Acid, HF.—When sulphuric acid is poured upon a fluoride, as, for example, fluor spar, hydrofluoric acid is given off as a colorless gas. The reaction between sulphuric acid and fluor spar is represented by the equation:

$$\underset{\text{Fluor spar, or calcium fluoride.}}{CaF_2} + H_2SO_4 = \underset{\text{Calcium sulphate.}}{CaSO_4} + \underset{\text{Hydrofluoric acid.}}{2HF.}$$

The acid is liquid below 67° F. It acts upon glass, and is used for the purpose of etching on glass. It acts upon the skin, causing swelling and violent pains. Inhaled it is extremely poisonous.

Revised by IRA REMSEN.

Fluorite: See FLUOR SPAR.

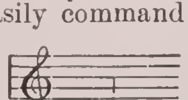
Fluor'otype [*fluor*ine + *-type*, from Gr. τύπος, stroke, mark, impression]: See PHOTOGRAPHY.

Fluor-spar, **Fluor**, or **Fluorite** [from Lat. *fluor*, flux, deriv. of *flu'ere*, flow, in allusion to its use as a flux in metallurgical operations]: a mineral composed of fluoride of calcium (F48·7 per cent., Ca51·3 per cent.). It crystallizes in the monometric system (in cubes, octahedra, etc.), and has a perfect octahedral cleavage. Its hardness is 4 (see HARDNESS), and its specific gravity 3·18. It occurs frequently very perfectly crystallized, and of beautiful and bright colors; pulverized, it becomes below a red heat brilliantly phosphorescent. It is sometimes carved into ornaments, and is used in the arts as a source of hydrofluoric acid for etching, and, as above stated, as a flux. See the article FLUORESCENCE.

Flushing [Dutch *Vlissingen*]: a strongly fortified seaport of the Netherlands; in the province of Zealand (see map of Holland and Belgium, ref. 8–C); on the island of Walcheren, at the mouth of the Western Scheldt. In connection with the ports of Rammekens and Breskens it commands the entrance of the Scheldt. Its harbor, accessible to vessels of the largest size, is one of the safest and most commodious ports of the European continent; there are extensive dockyards and a floating dock. Flushing is connected with Queenborough in England by a daily line of steamers. The principal exports are wheat, beans, fish, and cattle; the principal imports, coal from England, and coffee, tea, and tin from Java; the principal manufactures, oil and soap. Pop. (1891) 13,500.

Flushing: formerly a village; now part of the borough of Queens, New York city; Queens co., N. Y. (for location of county, see map of New York, ref. 8–K); situated at the head of Flushing Bay. It has several institutions of learning, an asylum for infants, extensive tool-works, dye-works, electric lights, gas-works, water-works, and a street railway connecting with College Point. Gardening, the nursery business, and fruit-raising are leading pursuits. Pop. (1880) 6,683; (1890) 8,463. EDITOR OF "JOURNAL."

Flustra: a genus of marine polyzoans, the species of which have the semi-common name "sea-mat."

Flute [M. Eng. *floute*, *floite*, from O. Fr. *flaüte*, *flahute* (> Fr. *flûte*), from deriv. of Lat. *flatus*, blowing]: a tubular wind instrument of very ancient origin. It is used in every part of the world, and has always had two principal forms. One of these is held straight before the performer, who blows into the end of the tube; the other is closed at one end, is held sideways, and is blown into through a lateral hole. This latter has been known as the German flute; from the former the flageolet has been derived. The German flute alone has been found worthy of orchestral and solo use. Modern flute-players easily command a compass of three octaves, beginning with  as the lowest tone. Since about 1830 the flute has undergone many changes and improvements; more than any other instrument. The bore has been altered and the fingering, number, and disposition of the keys have been entirely changed according to the system of Boehm. DUDLEY BUCK.

Flux [from Lat. *fluxus*, flow, flowing, deriv. of *flu'ere*, *fluxum*, flow]: a substance or mixture used to promote the fusion of bodies. Limestone is the usual flux for ores of iron in the blast furnace; it unites with the alumina and silica of the ore, forming a fusible slag. To flux silica and silicates, alkaline or basic fluxes are selected, as carbonate of soda or potassa, litharge, lime, or carbonate of lime; fluor spar is very effective. For lime, alumina, oxide of iron, etc., acid fluxes are selected, as borax, silica, glass, etc. Niter and litharge are both oxidizing agents and fluxes, while cyanide of potassium is a reducing agent as well as a flux; it frees metals, such as lead, from sulphur and from oxygen. *White flux* is a mixture of carbonate, nitrite, and nitrate of potassa, prepared by projecting a mixture of equal parts of niter and argol or crude cream of tartar into a hot crucible in successive small portions. It is an oxidizing flux. *Black flux* is prepared of the same materials and in the same manner as white flux, but the quantity of argol employed is double that of the niter. As this proportion of niter is not sufficient completely to oxidize the carbon of the argol, the mixture contains only carbonate of potassa and carbon. It consequently reduces metallic oxides by the union of the carbon with the oxygen. *Morveau's reducing flux* is composed of 16 parts of window-glass, 2 of calcined borax, and 1 of charcoal. *Flux for colored flames* before the blowpipe.—To enable the lithium, sodium, potassium, strontium, copper, etc., contained in minerals to color the blowpipe flame, Poole recommends a flux composed of 1 part of fluor spar and 2 parts of sulphate of lime (selenite). *Deflagrating fluxes*, for decomposing silicates, are very convenient in qualitative analysis, as they enable the student to do without the platinum crucible. For the detection of alkalies a flux composed of nitrate of baryta and charcoal is prepared. This is mixed with the finely pulverized mineral, placed on a plate of sheet iron, and fired with a match. On treating the residue with water a solution will be obtained which can be tested as usual for potassa and soda. For the detection of other bases a flux composed of carbonate of soda, nitrate of soda, and charcoal is employed; the residue, after deflagration, being treated with hydrochloric acid, evaporated to dryness to render the silica insoluble, moistened with hydrochloric acid dissolved in water, filtered, and tested for bases as usual. This flux may also be used for the decomposition of insoluble sulphates of barium and strontium. On treating the residue after deflagration with cold water, and filtering, the sulphuric acid will be found in the filtrate, and the bases on the filter as carbonates.

Fluxions [from Lat. *flu'xio*, a flowing, deriv. of *flu'ere*, *fluxum*, flow]: an old term for the differential and integral calculus, the term fluxion being applied to Sir Isaac Newton's conception of the differential or derivative which occurs in the calculus. From this point of view, a variable quantity is considered as one which is constantly growing, or being generated, as a line is generated by the motion of a point. That portion of the quantity or line which has been generated up to a certain time is called a *fluent* (deriv. of Lat. *fluere*, flow) or *genitum* (deriv. of Lat. *genere*, beget), while the rate at which it is being generated at any moment, or the infinitesimal element generated in an infinitesimal period of time, is called a *fluxion*. Thus a "genitum" corresponds to what is now called an integral, and a fluxion to a differential or derivative.

The idea of fluxions is frequently introduced in teaching beginners the calculus, and affords one of the best illustrations of its principles. But it should not be forgotten that it is only an example of an application of the calculus, and quite distinct from a differential. The modern conception of the subject, founded on the theory of limits and infinitesimals, though hard to acquire, is really simpler than the conception of a fluxion. S. NEWCOMB.

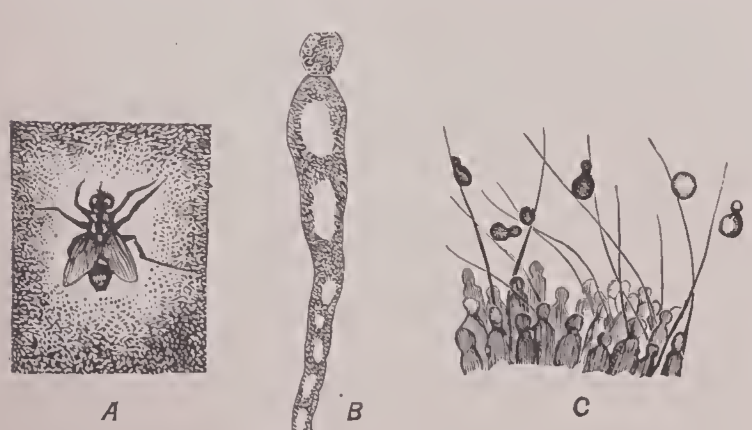
Fly [M. Eng. *flie*, *flege* < O. Eng. *flȳge*, *flēoge* : O. H. Germ. *flioga* > Germ. *Fliege*]: any one of the two-winged insects of the order DIPTERA (*q. v.*). The common house-flies (most of which belong to the species *Musca domestica*) lay their eggs in horse-manure, and hence proximity to a stable is apt to produce an abundance of these nuisances. The flesh-fly, or blow-fly, *Sarcophaga carnaria*, lays its eggs in meat of all kinds. The horse-flies belong to the genus *Tabanus*, the bot-flies to *Œstrus* and *Hippobosca*. The Hessian fly is not a true fly, but a hemipterous insect. Many species of flies are to be regarded as beneficial, as they act as scavengers and remove much noisome matter. See ENTOMOLOGY. J. S. K.

Fly-catchers: a name applied at first to birds of the genus *Muscicapa*, but now applied to a large number of American birds, none of which are of the above genus. They are assigned to the *Tyrannidæ* and other families of the order Passeres. They are distributed in many genera. These birds all have the habit of waiting until insects come near

The king of the fly-catchers.

them, when they dart upon them with wonderful quickness. The king-bird, *Tyrannus carolinensis*, is one of the best known in the U. S. The Savannah fly-catcher, *Milvulus savanna*, is found in the Southern U. S. The most common bird of the family in Europe is the so-called spotted or gray fly-catcher, which is a common summer visitant over the whole Continent and Great Britain.

Fly Fungus: a parasitic plant (*Empusa muscæ*) which attacks domestic flies and often destroys great numbers of them, especially in the autumn (Figure A). It is a plant of quite simple organization, and is apparently related to the black moulds (*Mucoraceæ*) in the order Conjugatæ of the class *Chlorophyceæ*. It is now included, along with a number of related species (forty or more), in the family *Entomophthoraceæ*. The fly fungus consists of short, tubular threads (Figure B) which grow through the tissues of the insect, and at length push through its skin, where small termi-



Fly-fungus: A, dead fly surrounded by spores; B, spore-bearing thread; C, portion of fly with protruding spore-bearing threads.

nal spores are produced by abstriction (Figure C). Just at the time when this happens the fly fastens itself securely to some object, swells up, and dies. In a short time the spores fall and surround the insect with a white halo-like powder (Figure A). Resting spores formed by conjugation were discovered by Dr. Winter, but they have rarely been seen by other observers. In some related species, as, for example, in the grasshopper fungus (*E. calopteni*), resting spores are very numerous. CHARLES E. BESSEY.

Flygare, ÉMILIE: See CARLÉN, EMILIE.

Flying [deriv. of verb *fly* < M. Eng. *flien*, *fleyen*, *flegen* < O. Eng. *flēogan*: Goth. *flaug-* in *us-flaugjan*, make fly away: O. H. Germ. *fliogan* > Mod. Germ. *fliegen* < Teuton. *fliugan*]: the motion of a living animal through the air when propelled by its own wings. Among vertebrates, most birds and all the bats possess, and the pterodactyl and some other fossil reptiles once possessed, the power of flight. It is probable that flying fishes also have a limited power of true flight, the pectoral fins serving as wings. Many insects also have the power of flying, but their wings, though functionally analogous, are not structurally homologous to those of vertebrates. In the latter the wing is the representative of the arm and hand or anterior limb of other vertebrates. The so-called flight of the flying squirrels, flying dragons, etc., is by no means a true flight. The parachutes (not wings) of these animals enable them to glide safely through the air, simply prolonging the leap of the creature, or at most joining to a parachute-action that of a sail or a kite.

The *mechanics* of flying are not yet well understood. In some birds the shape of the quills is such that at the stroke of the wing the greatest possible surface is opposed to the air; while in the *recovery*, or expansion of the wing, the edge of the quill-feather is opposed to the air. Bats are thought to fold the wing partially during the recovery, and the same may be true of some insects, and even birds. The more rapid closure of the wing also secures a greater resistance from the air during the stroke than can be offered during the expansion of the wing.

There are many varieties of flight among birds; of these among the most remarkable is the sailing motion, in which the wings are but slightly moved. There is considerable doubt as to the means by which such birds as the condor and albatross can maintain their long and almost motionless poise in the air.

Flying Buttress: See BUTTRESS.

Flying Dragon, or **Flying Lizard**: a name applied to lizards belonging to the genus *Draco* and closely allied genera of the family *Agamidæ*, in which the ribs are elongated and exserted, supporting lateral expansions of membrane which serve the animals as parachutes. The type of the group is *Draco volans* of the Indian Archipelago. The term flying dragon, in addition to its mythological application, has sometimes been applied to the extinct *Pterodactylus*.

Flying Fishes: fishes of the genus *Exocœtus* living in large schools in the open sea. They will "fly" a distance of from a few rods up to about an eighth of a mile, rarely rising more than 4 feet from the water. Their movements in the water are extremely rapid. The sole source of motive power is the action of the strong tail when in the water. No force is acquired when the fish is in the air, but when it rises from the water the movements of the tail are continued until the whole body is out of the water. When the tail is in motion the pectorals seem to be in a state of rapid vibration, but this is apparent only, and is due to the resistance of the air to the movements of the fish. While the tail is in the water the ventral fins are folded. When the action of the tail ceases the ventrals are spread and held open. They are not used as wings, but rather as parachutes. When the fish begins to fall the tail touches the water, when its motion again begins, and with it the apparent movement of the pectorals. The fish is thus able to resume its flight, which it finally finishes with a splash. When in the air it resembles a large dragon-fly. The motion is very swift—at first in a straight line, but later deflected in a curve. It has no relation to the direction of the wind. When a vessel is passing through a school of these fishes they spring up before it, flying in all directions like grasshoppers in a meadow. About thirty species of flying fishes are known, ten of them being found in the North Atlantic. The largest species, *Exocœtus californicus*, of the California flying fish, reaches a length of 18 inches; the others range from 6 inches to a foot. All are excellent food-fishes. DAVID S. JORDAN.

Flying Fox: a name sometimes given to the *Galæopithecus* (see FLYING LEMURS), but more frequently applied to the fox-bats, or large fruit-eating bats of the genus *Pteropus*.

Flying Gur'nard: See DACTYLOPTERUS.

Flying Lemurs, or **Colugos**: a name often applied to two curious insectivorous mammals, *Galæopithecus volans* and *G. philippensis*; characterized by a thin membrane extending from the fore to the hind legs, and thence to the tip of the tail. When fully extended this membrane forms so effectual a parachute that the animals can pass over distances of 200 feet, with a descent of about 50. They are nocturnal in habit, and, like bats, sleep hanging head downward. They inhabit the forests of the Malay Peninsula, Borneo, Sumatra, and the Philippine islands. See INSECTIVORA. F. A. LUCAS.

Flying-machines: machines and apparatus employed by man in the navigation of the air, and distinguished from balloons by the fact that they depend for support solely upon their own efforts, precisely as birds do. Since the article on the general subject of AËRONAUTICS (*q. v.*) was written progress of notable extent has been made in the construction of flying-machines. The basis of this advance is the work of inventors like Hargreaves and Maxim and Liliendahl, and the scientific researches of Langley and others. The inventors have established the fact of the possibility of constructing steam-engines and other forms of motor weighing from 3 to 5 or 6 lb. per horse-power, and the latter have proved the practicability of securing ample supporting power at high speeds by the action of the aëroplane alone, with no greater impelling power than is required for the forward motion of the machine. Flying has now been actually accomplished by both Maxim and Langley, and a soaring flight, without other impulsion than that given at the start by running or by drifting downward for some distance, has been effected very successfully by Liliendahl.

The question of the possibility of artificial flight by means of flying-machines has been seen to have long ago become settled affirmatively. Langley's and Maxim's experiments prove that the resistance to forward motion with well-shaped forms is insignificant. The former has shown conclusively that ample supporting power at high speeds may be obtained with aëroplanes, and that, within what are regarded as practical limits, the power demanded for impulsion is lower at the higher than at the lower speeds. It has been well settled that the power demanded, as a maximum, is about 1 horse-power for 25 lb. weight, and it is known that birds, within these limits, can usually carry 50 per cent. of their own weight as load. It is further shown by both Maxim and Langley that it is perfectly practicable to build steam-machinery weighing but a fraction of the limiting weight for any stated power and on a scale, in the case of Maxim's machine, of several hundred horse-power. Hargreaves has made fourteen model flying-machines which actually fly, and over distances of several hundred yards. Maxim, July 31, 1894, flew about 100 yards, and was stopped by the springing of his guide-arms. Langley's machine flew 900 feet, Dec. 13, 1894. Liliendahl's soaring flight has attained 1,500 feet.

Liliendahl's apparatus is simply a set of wings and a tail fitted to the person, and manipulated in such manner as to take advantage of the supporting power of the atmosphere acting on aëroplanes, while retaining, for considerable distances, an initially imparted velocity.

Maxim's machine consists of a framework of seamless steel tubes of varying sizes, connected with a square frame of white cloth, 50 feet by 50 feet at the top, and all starting from and neatly connected with an inclined wooden platform, built of narrow strips of wood—very strong, but very light. The platform measures 8 feet wide by 40 feet long. The large cloth frame is the aëroplane. There is also an aëroplane above the platform and ten additional side aëroplanes or wings, five on either side, and yet another, which surmounts the entire structure. The area of the main aëroplane is 2,874 sq. feet; of the small one, 126 feet; and of the bottom of the car or platform, 140 feet. With the rudders and wings added the total area is about 6,000 sq. feet.

Rudders and wings, like all the other aëroplanes, are made of a specially woven cotton-cloth, so fine in texture that it is impossible to blow through it, and mounted on a strong but extremely light framework of hollow steel tubes. All these aëroplanes are inclined at the angle which gives the most support, combined with the least resistance, to forward motion.

The screws are 17 ft. 11 in. in length, 5 feet wide at the ends, and 22 inches at the waist. They are made of American yellow pine, covered with canvas, and are painted a pale blue, the paint having been sandpapered to perfect smoothness, and in order to reduce the skin fraction to a point at which it becomes negligible. There are two compound steam-engines, weighing, with their steam-generator, approximately 1,960 lb., and capable of developing 300 horse-power. A compound engine has been constructed, the high-pressure cylinders of which are 5 inches in diameter, with a 12-inch stroke. The low pressure is 8 inches in diameter, with a 12-inch stroke. The piston speed is 800 feet per minute.

The boiler is inclosed in a house 8 feet long, 8 feet wide at the base, and 6 feet high. The sides of this house are made of asbestos-cloth, and the frame and top of thin iron. There are 7,600 naphtha gas-burners, which can be instantly ignited or extinguished, or increased from a tiny glimmer to full flame. The boiler has 600 tubes which are 8 feet long, and 200 tubes which are 4 ft. 10 in. long. These tubes are $\frac{1}{2}$ inch external diameter, and $\frac{1}{2}$ mm. or $\frac{1}{50}$ inch in thickness. They are curved and joined to a steam-drum 10 inches in diameter and 8 feet long, where the water and steam are separated, the water again passing through the boiler and the steam passing to the engine. There are also some 300 or 400 smaller tubes constituting a feed-water heater. In order to prevent the tubes from being injured by the great heat of the fire, a forced circulation is employed. The boiler is designed for a pressure of 410 lb. to the square inch; the engine, at 325 lb., has developed 300 brake horse-power. The machine carries 600 lb. of water and 200 lb. of naphtha. The consumption of naphtha is about 1 lb. per horse-power per hour.

This machine, on July 31, 1894, rose from the earth, carrying its inventor and two assistants, and flew 300 feet or more, and, as the first instance of actual flight by man, this will undoubtedly be forever recorded among the remarkable dates of chronology. The construction of the steam-engine, of the boiler, and of the flying-machine itself, will each be reckoned as wonderful triumphs of the inventor. The speed attained on the occasion referred to above was about 50 miles an hour. The lifting power of the machine was about 5 tons. Were the machinery of the largest contemporary steamship constructed of similar proportions of weight to power, it would generate more than ten times as much power as at present—about 350,000 horse-power.

Prof. Langley's first attempt at flight was made, successfully, on the afternoon of Dec. 8, 1894. The machine is an aëroplane driven by screw propellers and impelled by a small steam-engine of marvelous lightness and power. The machine is 12 feet in length and 8 feet wide, and has two sets of wings, the forward and main pair of about double the spread of the after set. The hull of this air-ship is made largely of aluminium; it is 4 feet in length, 2 feet wide, and weighs 2 lb. The aëroplane wings are made of a very light, strong, and stiff framing, covered with thin but strong cloth.

An air-ship constructed by Count Zeppelin made several successful ascents in 1900, the most notable being at Friedrichshafen on Oct. 21, when for several hours the machine was successfully manipulated in a heavy wind.

Flying Phalan'ger [from Fr. *phalanger*, deriv. of *phalange*, phalanx, viâ Lat. from Gr. φάλαγξ]: any one of several marsupials of Australia and the neighboring islands. They are surprisingly like the flying squirrels in appearance and habits, and are, in fact, the marsupial representatives of those squirrels. The species are rather numerous. The largest, the *Petaurus flaviventer*, is 20 inches long, and its tail measures 18 inches. The smallest, *Acrobates pygmæus* is 2 inches long, and its tail is of the same length.

Flying Squid: a name given to the cephalopods of the genus *Ommastrephes*, of which there are many species known, varying in length from an inch to 4 feet. They have the power of leaping from the water, whence the name. They are preyed upon by sperm-whales, birds, and fishes, and are largely employed as bait by fishermen.

Flying Squirrel: any animal of the genus *Sciuropterus* (family *Sciuridæ*), characterized by a hairy expansion of the skin between the fore and hind limbs by which the animal is enabled to glide from tree to tree in very prolonged leaps. The tail also aids to support it in the air. The common species of the U. S. is *S. volucella*.

Flynn, EDMUND JAMES: See the Appendix.

Fly-wheel: a balance-wheel; a heavy wheel carried on the main shaft of a steam-engine, or attached to other machinery, for the purpose of securing a steady motion where the power and the load are not in precise equilibrium at all times. It insures the comparatively slow variation of speed about a mean value which is usually that proposed for the regular working of the machine. In the steam-engine the variations of energy acting on the wheel, and absorbed or given out by it, come in part from the varying effort of the steam in the cylinder, in part from the varying turning power of the piston acting on the crank and its shaft, and in part from variations of the load driven by the engine. The latter is called an external variation of load; the others are internal. In its operation the varying speed determines the energy stored in the revolving rim of the wheel, and the variations in the magnitude of this energy, $\frac{WV^2}{2g}$, measure and balance the differences between the power exerted by the engine at the given instant and the work absorbed by the load. In a cotton-mill the variations in these differences of effort and resistance are due to internal variations of effort; in a rolling-mill they are consequent upon the rapid and great variations in the resistance of the rolls.

R. H. Thurston.

Fo, or **Foh**, also **Fo-to** [Chinese < older Chinese *Bod*, from Sanskr. *Buddha*]: the Chinese equivalent of Buddha (*q. v.*). Hence Buddhism as it exists in China is sometimes called *Fohism*, and the votaries of Buddhism *Fohists*.

Focus [Lat., hearth, fireplace]: a point at which rays of light meet after deviation by a lens or mirror.

Focus of a Conic Section.—A point on the principal axis through which a double ordinate to that axis is equal to the parameter. The ellipse and hyperbola have each two foci, and the parabola has one. In all the conic sections the foci possess the remarkable property that they are the only points in the plane of the curve from which the distance to any point of the curve can be expressed rationally in terms of the abscissa of that point. The name *foci* was given to these points from the property that rays of light proceeding from one focus and reflected from the curve pass through the other focus. In the *ellipse* rays of light from one focus reflected from the curve pass directly through the other focus; in the *hyperbola* rays of light from one focus reflected from the curve take such directions that on being produced backward they will pass through the other focus; in the *parabola* a second focus on the principal axis at an indefinite distance may be supposed, in which case rays from either focus reflected by the curve will go to the other focus. In the last case rays from the second focus are parallel to the principal axis, and after reflection they go to the first focus; rays from the first focus are parallel to the principal axis after reflection. If either of these curves is revolved about its principal axis, it will generate a surface of revolution whose foci are identical with those of the generating curve. Rays of light from either focus of such a surface will be reflected from the surface in accordance with the laws already explained.

Focus of a Lens or Mirror.—The point from which rays of light proceed before being deviated by a lens or mirror is called a *radiant* point: if the rays converge before deviation they must be produced beyond the lens to meet, and this point of meeting is called a *virtual radiant*. The point at which the rays meet after deviation is called a *focus*; if the deviated rays diverge after deviation they must be produced backward to meet, and this point of meeting is called a *virtual focus*. The radiant point and focus are reciprocal; that is, if the focus be taken as a radiant, the radiant will become the focus. Any two points so related with respect to a lens or mirror are called *conjugate foci*. The *principal focus* of a lens or mirror is the focus that corresponds to rays parallel to the axis. In this case the radiant point is on the axis at an indefinite distance. Rays proceeding from the principal focus are so deviated as to be parallel to this axis. In this case the focus is on the axis at an indefinite distance. In all cases the conjugate foci are on a line through the optical center of the lens or mirror.

Fodder: See Forage.

Fœtus [Lat. *fētus*, *fœtus*, the bringing forth, offspring, fruit, connected with *fēcundus*, fruitful, *fētu'ra*, generation, *fēnus*, interest, and probably from I.-E. root *dhēi̯-*, *dhē-*, suck, suckle, repr. in *fēmina*, θῆλυς, etc.]: the name given to the young of viviparous animals during the greater part of their existence before birth. The intra-uterine life of the human product of conception is divided into three epochs: the stage of the *ovum*, of the *embryo*, and of the *fœtus*.

To the stage of the *ovum* belong the *first two weeks* of existence, including the period from the moment of conception to the formation of the rudiments of the future being. The details of this *blastodermic stage*, as it is also frequently termed, for man are largely conjectural, founded upon the observations upon the lower animals, since the youngest well-authenticated human ovum examined was already probably twelve days old.

The *embryo* stage embraces from the second to the close of the fourth week, the period of greatest developmental activity, during which the principal organs are established and the provisional division effected by transient embryonal structures, as the somites, visceral arches, etc. (see Embryology), is replaced by the permanent differentiation resulting in the definite form of the fœtus.

The transition of the embryo into the fœtus occurs gradually, and, although the demarkation is somewhat arbitrary and conventional, it may be assumed to take place when the embryo reaches a length of between 13 and 16 mm., or at about the beginning of the fifth week. Before this period the appearance of the human embryo is insufficient to distinguish it with certainty from similarly advanced embryos of other mammals; after attaining a length of 16 mm., on the contrary, the distinctly human features are so pronounced that the recognition of the embryo as that of man is no longer uncertain.

While for the accurate descriptions of the anatomist adherence to the foregoing stages is desirable, for general purposes it is unnecessary, and the term fœtus will here be employed as denoting the young animal without strict regard to its embryonal and fœtal stages. The early stages of the ovum and the fundamental embryological processes having been described in the article Embryology, a consideration of the *external characteristics* of the human fœtus will here claim attention.

In its earliest stages the human fœtus is only slightly bent. At the end of fifteen to twenty days the head comprises the expanded *brain-vesicles* and the imperfectly formed series of *visceral arches*; the heart appears as a sigmoid tube, and the widely open gut is in free communication with the large umbilical vesicle.

Very soon (by the twenty-third day) the embryo becomes markedly flexed, so that its cephalic and caudal extremities are brought into contact. The completion of the visceral arches and the appearance of limb-buds also mark this stage. Toward the end of the fourth week the head, which meanwhile has assumed conspicuous proportions, becomes less acutely bent, and shows indications of the beginning of the return to the more erect position which later follows. Coincidently with these changes the eye and the ear become more prominent, the external portions of the auditory apparatus appearing as the persistent first visceral cleft, the remaining furrows gradually disappearing.

By the fourth week the extremities, which very early appear as flattened projections, are well advanced, the separation of the upper limb into the arm, the forearm, and the hand, with an indication of the division into fingers, having been established. The upper extremity first develops, and consequently anticipates in its differentiation the lower limb; the formation of the fingers and toes is not completed until about the ninth week.

The series of visceral arches mentioned play an important *rôle* in the development of the face, since by the growth and specialization of these structures the boundaries of the nasal and oral cavities are largely formed. In man four pairs of these arches exist; the first becomes partially cleft into the upper or *maxillary* and the lower or *mandibular* division; union and fusion of the lower projections contribute the tissues from which the inferior boundary of the mouth is derived, the upper border being formed by the union of the superior divisions of the arches with a central nasal process. When the fusion of these parts is imperfect, the originally distinct processes remain separated by a fissure of greater or less extent; this defect constitutes harelip, which may be single or double according to the extent of the faulty union.

In the early embryo immediately in front of the lower visceral arches lies a conspicuous and tortuous projection, due to the underlying primitive heart; somewhat later, by the fourth week, the cardiac elevation has been completely overshadowed by the distension of abdominal walls, caused by the relatively excessive size of the fœtal liver, which at this period occupies a large portion of the entire body-cavity.

After the third month the fœtus is developmentally complete, the increase in its general bulk resulting from the growth and perfecting of the parts, which by this time have been established, and not by the addition of new structures. The rate of growth is very rapid during the third, fourth, fifth, and especially sixth months, the weight of the fœtus within this time increasing over a hundredfold. While the size and weight of the healthy fœtus are liable to considerable variation, the table given herewith represents, according to Hecker, the average weight of the fœtus:

Third month,	11 grammes.		Seventh month,	1,218 grammes.	
Fourth "	57	"	Eighth "	1,569	"
Fifth "	284	"	Ninth "	1,971	"
Sixth "	634	"			

The *nutrition* of the fœtus during the earlier weeks is carried on by the absorption of nutritive tissue-juices derived from the surrounding structures; by the end of the third month the respiration and nutrition of the fœtus are provided for by the formation of the *placenta* (see EMBRYOLOGY), by means of which the blood of the fœtus is brought into intimate relation, but not actual contact, with the maternal circulation, thus affording the opportunity for interchange and absorption.

The placenta is the organ for the purification of the blood before birth, and is connected with the body of the fœtus by means of the important *umbilical blood-vessels*, the two arteries, and the single vein. The arteries return the venous current from the fœtus to the placenta, and the umbilical vein carries the freshly oxygenated blood back to the fœtus. The renewed blood passes first to the liver, and after traversing this organ is emptied into the great *inferior caval vein*, which in time pours its blood-stream (composed of blood returned from the lower half of the body as well as from the liver) into the right auricle of the heart. Notwithstanding the large size of the liver, this organ during the later months of gestation is unable to receive the entire volume of blood returned from the placenta by the umbilical vein; in consequence, it becomes necessary to establish an additional path by which the excess of blood may reach the vena cava on its journey to the fœtal heart; relief is afforded by the formation of a new blood-channel, the *ductus venosus*, which extends between the umbilical vein and the inferior caval vein; through this canal a large part of the blood brought by the umbilical vein from the placenta is directly carried into the venous current returning from the lower half of the body.

The *fœtal circulation* is characterized by peculiarities in the course of the blood-current rendered possible by the existence of passages which disappear shortly after birth. One of these channels, the *ductus venosus*, has already been mentioned; another exists as an opening (the *foramen ovale*) in the interauricular partition of the heart through which the blood-current brought by the inferior cava and guided by the *Eustachian valve* passes directly from the right into the left auricle. Again, the limited capacity of the unexpanded fœtal lungs is unequal to the reception of the entire blood-stream carried by the pulmonary artery, a condition necessitating the establishment of an additional means of carrying off the excess; this is provided for by the *ductus arteriosus*, a short cut placed between the pulmonary artery and the descending aorta, by means of which channel most of the blood forced from the right ventricle finds passage into the descending current distributed by the aorta to the lower half of the body. Before passing into the lower limbs the blood-stream is divided, a large part entering the *hypogastric arteries* (the direct intrafœtal continuations of the *umbilical arteries*) and returning to the placenta, while the remaining smaller part supplies the lower limbs. It will be seen from the foregoing that, after leaving the liver, at no point within the circulation of the fœtus is the blood-current composed of strictly arterial blood, but that the various organs are supplied by blood more or less contaminated with that already in use.

After birth, with the cessation of the placental circulation and the establishment of pulmonic respiration, the blood-current is limited to the paths definitely followed throughout life, the temporary channels afforded by the ductus venosus, the foramen ovale, the ductus arteriosus, and the hypogastric arteries becoming obliterated, and remaining during life as atrophic structures.

The contractions of the fœtal heart are more frequent than those of the child after birth, from 135 to 145 beats per minute on the average taking place. While by no means always so, yet the heart-beats are usually more frequent when the fœtus is of the female sex. This fact has been utilized in predicting the sex of the fœtus; in about 66 per cent. of cases where the contractions number less than 135 per minute the fœtus proves to be male, while about an equal proportion prove to be female when the pulsations exceed 145 per minute.

During intra-uterine life the sustenance of the fœtus is carried on by the nutritive materials absorbed from the maternal blood; the digestive glands consequently remain imperfectly developed until called into functional activity by the ingestion of food. Secretion and excretion are carried on by the cutaneous glands and the kidneys, as evidenced by the sebaceous material covering the surface of the fœtus and the urine; the latter is first collected within the allantois, and later, together with the contents of the digestive canal, expelled into the amniotic fluid, by which the fœtus is surrounded during the later months of its sojourn within the uterus. At the time of birth the fœtus possesses an average length of from 20 to 21 inches and an average weight of about 7 lb. For the details of the processes connected with the early formation of the embryo and fœtus see EMBRYOLOGY. G. A. PIERSOL.

Foggia, fod′jăă: town of Southern Italy; capital of province of same name (see map of Italy, ref. 6-G); 75 miles by rail N. W. of Bari; the seat of a bishopric. It is a beautiful city, situated in the rich plain of Apulia, of which it is the commercial center. A celebrated fair is held here annually May 9-20. Pop. (1895) 45,700.

Fog-horn: See FOG-SIGNALS.

Fo′go: a port of entry of Newfoundland, and capital of Fogo island district; 122 miles N. W. of St. John's. Lat. of Fogo Cape, 49° 41′ N., lon. 54° W. It has important fisheries and considerable trade. Pop. 800.

Fogo, or **Fuego**, fwā′gō: one of the CAPE VERDE ISLANDS (*q. v.*); consists of a single volcanic cone rising 9,157 feet above the sea, and surrounded at the base with a steep wall of immense lava-blocks. Area, 171 sq. miles. The soil is extremely fertile, and produces grain, wine, fruits, and tobacco of the very first quality. But, besides suffering occasionally from the eruptions of the volcano, that in 1847 being very destructive, the island lacks water, and the droughts are sometimes so prolonged as to cause famine, during which thousands of the inhabitants are starved to death. Before 1834 the population numbered about 17,000, but in the three dry years it sank to 5,600, and it has risen very slowly since, becoming 16,004 in 1885.

Fogs [of Scandin. origin; cf. Dan. *fog*, drift, spray, shower, storm; Icel. *fok*, spray, drift]: clouds at the surface of the earth. They are produced by the condensation of the vapor of the atmosphere into liquid particles of extreme minuteness. De Saussure thought these particles were vesicles, and not solid globules, and that their suspension in the atmosphere was due to the rarefaction of the air within them, caused by the radiant heat absorbed from the sun. But later meteorologists do not subscribe to this hypothesis—first, because it is impossible to conceive of any operation of nature by which such hollow globules could be formed; and, secondly, the formation of the rainbow is in strict accordance with the laws of the refraction of light from solid globules. Furthermore, Plateau of Ghent has shown by a very ingenious experiment that the particles of fog do not contain air. For this purpose he filled a glass tube, closed at one end, with col l water; then gradually inverted it with such precaution that the water was sustained in the tube by the pressure of the atmosphere. Under the mouth of this tube was placed a rising column of steam or visible vapor, which was condensed by the surface of cold water with which it came in contact. The contractile power of the bubbles would in this case eject any air which might be contained in them into the column of water, where its presence would in due time be made manifest, especially by the aid of a magnifying-glass. No air was found by this experiment. The suspension of the cloud is due to the extreme fineness of the globules, and also perhaps slightly in the daytime to the higher temperature of the air which surrounds them. The rising of a fog from the surface of the earth is evidently due to the latter cause, when the source of vapor is cut off. A fog is produced when a gentle current of warm air surcharged with moisture passes over a colder surface, as is the case especially on the lower Mississippi river during the prevalence of a warm southerly wind in the early spring. At this season of the year the water of the lower river, having come from a northern latitude, is much colder than the air above it, and hence a precipitation of the vapor takes place.

A fog, however, is not produced in absolutely still air even when resting on a colder surface. In order to this effect it is necessary that two strata of air be mingled with each other, one of which, being the colder, precipitates on itself, as it were, the particles of invisible vapor of the other. This fact is illustrated by the phenomenon of dew, in which atmospheric vapor is condensed into water without producing fog. In this instance the process may be conceived as follows: An indefinitely thin stratum of air resting directly upon a surface cooled by radiation deposits its moisture, leaving it unsaturated; the vapor of the stratum immediately above it is then diffused into the first stratum; the second is then unsaturated, and diffusion takes place into this from the third stratum, and so on, without the production of a fog. If, however, the radiation takes place into a clear sky from a sloping surface of ground, the colder and consequently heavier air resting on such surface will roll down into the valley, and there, mingling with the warmer saturated air, produce a fog. A fog is also produced when a current of cold air passes over warmer water or a warm damp soil. Water evaporates at all temperatures, and in the case just mentioned the vapor as it rises is condensed into visible fog. But the density of fogs produced in this way is not usually as great as that which is generated by the other process.

The eastern coast of the U. S. is especially subject to fogs, the cause of which will be readily seen, from what has been before mentioned, when the relative position of the currents on the western side of the Atlantic Ocean is considered. First, a cold polar current coming out of Baffin's Bay is thrown by the revolution of the earth laterally against the coast of North America from Labrador to Cape Hatteras, where it passes under the Gulf Stream. Contiguous to, but outside of, this current, and moving in an opposite direction, is the great Gulf Stream, an immense body of warm water, which throughout its whole course across the Atlantic heats and saturates with vapor the air immediately over it. Now, it must be evident that whenever the wind is in such a direction as to blow this warm and saturated air across the cold surface of the polar current, mingling the heated and moist air with the colder stratum, a fog must be the result. Hence the fogs on the Banks of Newfoundland, and also along the coast of Maine, whenever the wind is in a southerly direction, especially in the warm summer months. In proceeding southerly along the coast the direction of fog-bearing wind is found to be more and more easterly. Fogs are also produced on the western coast of North America when the wind from the exterior ocean passes across the coast current which comes from the N. The production of fog is in this case more complex, since the coast current is in fact the eastern portion of the great Gulf Stream of the Pacific. The northern part of this current is warmer than the surrounding ocean, while in its southern portion its temperature is less than that of the water through which it is passing. But in either case a fog will be produced when a wind of opposite temperature blows from the exterior ocean across this current. On the same principle fogs are produced in other parts of the world; and their existence may be inferred from the relative position of the cold and warm currents of the ocean. Fogs are sometimes associated with smoke in the atmosphere; minute particles of carbon radiating heat tend to become colder than the surrounding air, and thus condense the particles of vapors around them. London and other cities of England are frequently covered with fogs of this kind. See FOG-SIGNALS.

Fog-signals: signals made in foggy weather to prevent collisions or other accidents to vessels or railway trains. Along the eastern coast of the U. S. fogs prevail almost continuously at certain periods of the year; and as the shore is exceedingly precipitous the sounding-line can not be used with any certainty, and therefore fog-signals must be resorted to. Attempts have been made in France and Great Britain to penetrate fogs by means of lights of intense character, such as those of aluminium and electricity; but that these could not be successful must be evident from the consideration of everyday experience, that a mile of cloud —or, in other words, of fog—shuts out the image of the sun. Recourse must therefore be had to sound, which, when of a powerful character, is not materially affected in its propagation by fog.

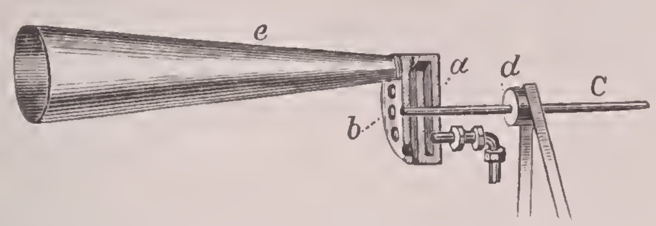
For the production of sound for this purpose bells, gongs, whistles, trumpets, and sirens have been used by the lighthouse board of the U. S. Although a powerful sound may be produced by a cannon, the shortness of its continuance and the blending of the echo with the original impulse render it less favorable to the precise determination of its direction than the prolonged sound produced by the trumpet or the whistle. Bells, even of a large size, give too feeble a sound to be distinguished across the breakers at a sufficient distance or in opposition to the wind; they are only used when a signal is required to give warning of danger at a short distance at intermediate positions. They are rung by a weight wound up at intervals, the descent of which is regulated by the vibration of a pendulum with clock escapement. In some cases an automatic apparatus actuated by the waves of the sea has been used for ringing a bell, but this device has not found favor with the U. S. lighthouse board, since every automatic instrument is liable to get out of order, and so fail to point out the direction of danger at a time when it is expected to do so. Uninterrupted action is a fundamental principle of lighthouse signals.

Gongs, although they appear to produce a powerful sound when near the ear, in reality give an impulse of too feeble a character to be heard under all circumstances at a distance.

The mechanisms which have been found to produce sound of the greatest penetrating power are those which depend upon the principle of resonance, such as the organ-pipe, the trumpet, and the whistle, in which the air itself becomes the sounding body, as well as the medium of conduction of the sound. Of this character is the ordinary locomotive whistle, in which the vibration is produced by a thin sheet of air striking against the edge of a resounding cavity called the bell. The stiffness—if the expression may be used—of the sheet of air depends upon the tension of the steam in the boiler; and in order that the vibration of this sheet may be in unison with the reverberation of the air in the resounding cavity, the sheet must be increased and diminished in length; which is effected by a screw, the turning of which increases or diminishes the distance between the narrow opening through which the sheet is emitted and the lower edge of the bell-shaped cavity. As the loud sound is produced in this instrument by the vibrations of the air in the resounding cavities, the form or material of the inclosure of the latter has little effect upon the result. Instead of the metallic cylinder, a square wooden box may be used, the orifice through which the sheet is ejected being made to correspond in form. The locomotive whistle is the simplest of the more powerful of the fog-signals employed by the lighthouse board of the U. S. It is actuated by an ordinary locomotive steam-boiler at a pressure of from 50 to 75 lb. per sq. inch. The sound is distinguished from that of locomotives and steam-vessels by the length of the blast and the interval between two soundings; and these are regulated and produced automatically by a small engine attached to the boiler, which opens and closes the valves, letting on and shutting off the steam at the proper intervals. The whistles employed are from 8 to 12 inches in diameter.

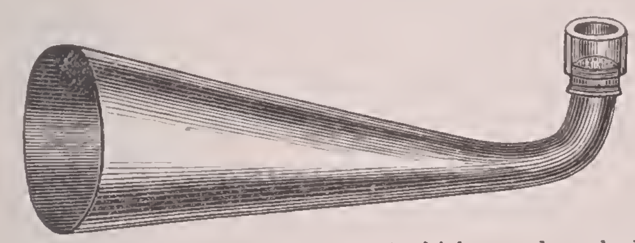
The next powerful instrument used is that called the reed or Daboll trumpet, actuated by air condensed in a reservoir by means of an Ericsson caloric (or heated-air) engine. In this instrument the trumpet itself is the resounding cavity, and the reed by its vibration produces the requisite motion of the air. The reed, consisting of a bar of iron, is, in the larger class of trumpets, 18 inches in length, 2 inches in width, and three-quarters of an inch in thickness at the fixed end, thinning gradually toward the free end. In order to gain the best effect, sound from these parts must be in unison, and for this purpose means should be provided for gradually increasing or diminishing the length of the trumpet. With a given stiffness of the reed the pressure of the air in the reservoir can not exceed a given intensity, since beyond this the reed can not recoil, and the orifice remains closed. A pressure of from 10 to 15 lb. per sq. inch is the maximum employed. This instrument is the most economical of power, giving the greatest amount of sound with a given expenditure of fuel. Its range of power, however, with a given size of trumpet is less than that of the 18-inch whistle; still it is a valuable instrument in all places where fresh water can not be obtained, since the motive-power consists of heated air, and not of vapor generated from a liquid.

Another instrument, and the most powerful of all yet employed, is the siren trumpet. The siren is the invention of Cagniard de Latour (see under ACOUSTICS, *Length of Sound-waves*), but its application as a fog-signal and the addition of the trumpet were patented by the Messrs. Brown, of New York. The sound from this instrument can be heard distinctly in still air at a distance of from 20 to 30 miles, even during the existence of a dense fog. The siren trumpet is



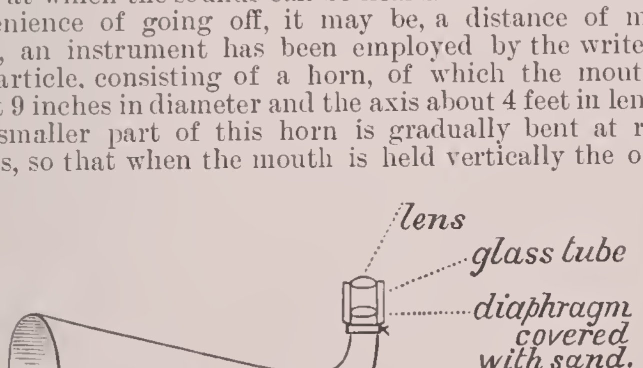
Explanation.—*a*, Steam drum, with one hole on front face; *b*, revolving plate, perforated with eight holes and supported on the shaft *c*.; *d*, a pulley, to which rapid motion is given by a band and driving-wheel; *e*, resonator or trumpet.

usually operated at a pressure of 75 lb. of steam, generated in a locomotive-boiler. It is not improbable that a better effect would be produced by using condensed air, since the space immediately around the point of origin of the sound is filled with steam, which must have an effect upon its subsequent transmission to the air. On the other hand, however, the increased complexity of machinery would probably more than neutralize any increase of effect from the change in question. By increasing the number of revolutions of the disk the pitch of the sound may be changed, and by this means the fact has been established that a medium pitch gives a sound of a greater penetrating power than one lower or higher. It is probable that the effect upon the tympanum of the ear will be in proportion to the quantity of air moved, multiplied by the square of the velocity, since at a very high pitch the amplitude of vibration must be exceedingly



Trumpet for determining the distance at which sound can be heard.

small, as well as the quantity of air put in motion, and the effect will be less. The shrill sound of the boatswain's whistle is heard more distinctly at a moderate distance, not on account of its more penetrating power, but on account of its dissimilarity to the ordinary coexisting sounds. It is impossible to judge of the penetrating power of a sound by its effect upon the ear when placed near its origin. To ascertain this it is usual for the observer to separate himself gradually from the place of origin of the different sounds of which the penetrating power is to be compared; the relative penetrating power being determined by the distance at which the sounds can be heard. To obviate the inconvenience of going off, it may be, a distance of many miles, an instrument has been employed by the writer of this article, consisting of a horn, of which the mouth is about 9 inches in diameter and the axis about 4 feet in length. The smaller part of this horn is gradually bent at right angles, so that when the mouth is held vertically the open-



ing at the smaller end is horizontal. Across this smaller end is stretched a delicate membrane on which fine sand is strewn. When the instrument is held in the hand horizontally, and the mouth is directed toward a sounding instrument, the sand, protected from the wind by a cylinder of glass, is observed to be agitated. The instrument is then carried off from the source of sound until the sand ceases to be moved. The measured distance at which the agitation ceases is taken as the relative penetrating power of the sound under examination as compared with the standard instrument, such as a reed horn or a bell. This instrument has been found by repeated comparison to give the same relative indications as those of the ear. Its degrees of sensitiveness will depend upon the relative size of the mouth and of the smaller orifice. In the more perfect form of the instrument it is so constructed as to be capable of a slight increase or diminution in length—an adjustment which is necessary in order that the horn may not be in unison with the sound to be measured, since in that case the resonance would produce an exaggerated effect in the increase of distance at which the agitation of the sand would take place. With an instrument of this kind having a small mouth a series of experiments have been made to determine the number and best form of the openings in the head of the drum and the revolving plate of the siren, without going to a distance of more than a few rods from the instrument.

In experimenting with sounds of such powerful magnitude as those produced by the instruments already described, certain peculiarities are observed which escape detection in ordinary acoustic investigations with sounds of inferior power. An important one is that of the great divergence of powerful sounds. It is well known that there is a striking analogy between the reflection of sound and that of light—that sound, like light, may be concentrated and directed in parallel lines by concave reflection; but this appears to be true only to a limited extent, and perhaps for more feeble sounds, since we have found that although the sonorous ray from a parabolic reflector, in the focus of which a powerful steam-whistle is sounded, is more powerful in the direction of the axis of the reflector than in any other at a comparatively short distance—for example, a mile or so—yet when the distance is increased to 4 or 5 miles the effect of the reflector is almost entirely lost, and the sound in the line of the axis may be heard apparently with the same intensity behind as before the reflector. This lateral divergence of the sound explains some abnormal phenomena which have been observed; for example, when a building or an elevation of ground exists between the observer and the reverberating body, the sound of the latter may be distinctly heard at a distance, but is lost on gradually approaching it in a direct line, the observer falling, as it were, into the sound shadow. This frequently happens in cases where the instrument is placed on one side of an island. At a distance it is heard almost equally well in every direction, while nearer it can only be heard on one side of the island.

Another set of phenomena which are conspicuously presented in the observation of loud sounds are those which result from the effect of the wind. It is a fact of daily observation that sounds are heard farther with the wind than against it, and that even a gentle breeze produces a remarkable effect in the way of increasing or diminishing the intensity of a given sound. The explanation of this phenomenon is by no means simple, which will be evident to one who reflects that the velocity of sound is at the rate of 700 miles an hour, while that of a wind which will nearly obliterate the perception of the sound at a given distance may be only 3 or 4 miles per hour. The only explanation of the effect of a wind on sound is that first indicated by Prof. Stokes, of Cambridge. To understand this, recall the fact that a beam of sound consists of a series of waves the length of the crests of which is at right angles to the direction of the sound. Now, although the wind may have very little effect upon the absolute velocity of these waves, it may materially affect their relative position, and consequently the direction of the sound. To render this plain, suppose the beam of sound to be represented by a series of parallel rods which in still air are perpendicular to the horizon. Next suppose a wind blowing against the sound—that is to say, toward its origin; the stratum of this wind next the earth will be the most retarded, on account of friction and other resistance; the one next above less retarded; and so on toward the upper stratum, which will have the greatest velocity. The effect of a moving river of air of this character will be to cause the perpendicular rods representing the waves of sound to lean, as it were, backward, and the sound itself to take a direction upward, passing far above the ear of an auditor placed on the surface of the earth at a distance to the windward of the origin of the sound. An opposite effect will be produced by a wind in the direction of the sound; the upper parts of the rods or waves will be inclined downward, and the sound, which in still air would pass above the ear of the observer, would in this case be thrown down upon it. In accordance with this hypothesis, it must be evident that a variety of phenomena in regard to sound must result from the slight changes in the intensity and direction of the wind. Thus a sound which may be heard at a distance of 10 miles with a slight wind against it is lost on approaching its origin, or even becomes inaudible at several intermediate points by an imperceptible increase in the velocity of the wind at the surface—a greater change perhaps taking place above. That this phenomenon can not be explained by the interposition of strata of air acoustically rendered flocculent and opaque by an admixture of invisible vapor, is evident from the fact that in a case of this kind the whistle from an approaching vessel has been continuously heard while the sound from the instrument on shore has been, as stated above, interrupted in its passage.

That a sudden change in the condition of the air by its saturation with moisture will have some effect in the propagation of feeble sounds is evident from both experiment and analogy; but this cause is entirely insufficient to produce the effects described, since they are exhibited without any apparent change in the hygrometrical condition of the atmosphere. Besides this, the fact that they depend upon the direction of the sound with reference to the wind is conclusive evidence that they are the result of the latter. In the case of a series of observations by two observers, A and B, each sounding a powerful instrument, it frequently happens that when A can distinctly hear the sound from B, the sound from A can not be heard by B. To explain this phenomenon on the principle of an acoustic opacity produced by flocculency would require a medium which would transmit sound in one direction and not in the opposite.

Fo-Hi, or **Fuh-Hi**: a half-mythical character in Chinese history generally considered to be the founder of the Chinese nation. His accession is assigned in the Chinese annals to 2852 B. C., but is placed by Dr. Legge (*Yi-King*, p. 11) in 3322 B. C. He is said to have introduced social order, music, writing, and marriage, and established a kind of mystic religion, which superseded to a great extent the ancient star-worship. He is the reputed discoverer or designer of the pah-kwa or "eight diagrams," lineal figures of three lines each (either whole or divided), each figure representing some power in nature, either active or passive. These by combination and multiplication form the sixty-four hexagrams on which is based the text of the *Yi-King*, or *Book of Changes*, one of the Five *King* or classics of the Chinese. Fo-Hi is said to have copied these diagrams from the back of a tortoise. R. L.

Föhr: an island in the North Sea, off the west coast of Schleswig, to which it belongs; area, 25 sq. miles; pop. 4,150. It is a good bathing-place; the chief industries are fishing, oystering, and fowling.

Foil [M. Eng. *foil*, leaf, from O. Fr. *foil*, *foille*, *feuille* > Fr. *feuille* < Lat. *folium*, *folia* : Gr. φύλλον]: thin sheets of metal (gold-foil, tin-foil, etc.) thicker than the leaf metal of commerce. Gold-foil is obtained by beating. It is in fact unfinished gold-leaf, and is chiefly used by dentists for stopping decayed teeth. Tin-foil is obtained by rolling the metal or by shaving a thin layer from a block of tin in an ingenious machine, which not only cuts off the foil, but rolls and stretches it at the same time. It is much adulterated with lead. Pure tin-foil is of great use in chemistry and the arts. Foils of copper and other metals are used for the backing of gems by the lapidary. The skillful use of nicely colored foils sets off and greatly heightens the effect of most precious stones.

Foils: See FENCING.

Foix, fwaă: town of France; department of Ariège; at the foot of the Pyrenees (see map of France, ref. 9–E). It was the birthplace of Gaston de Foix and the residence of the Counts of Foix, of whose ancient castle only three towers remain. The town has some trade in iron. Pop. (1891) of commune, 6,177; (1896) 6,722.

Foix, COUNTS OF: French family prominent from the eleventh century to the sixteenth. The first to assume the title was ROGER, who inherited the town of Foix and adjoining territory from his uncle, the Count of Carcassonne. D. 1064.—A more noted name is that of RAYMOND ROGER, who succeeded to the county in 1188. He was a companion of Philip Augustus in the third crusade, and one of the heroes of the siege of Acre. In the persecutions of the Albigensians he exposed himself to the charge of heresy by championing their cause against Simon de Montfort, who attempted to gain possession of the count's lands. De Montfort fell at the siege of Toulouse 1218, and Raymond became reconciled to the Church a short time before his death in 1223.—Count ROGER IV. (1241–1265) rendered homage for his estates to the King of France.—His successor, ROGER BERNARD III. (1265–1302), was a better troubadour than warrior, and stands high among the Provençal poets. He was humiliated by his enemies, and taken prisoner both by the King of France and the King of Aragon.—GASTON III., surnamed PHŒBUS, was one of the most conspicuous figures of the time. He became count in 1243, fought in the war against the English, and for this was made governor of Languedoc, but was suspected of conspiracy with Charles the Bad of Navarre, and thrown into prison 1356. He was soon released, and fought on the side of the Teutonic knights against the heathen of Prussia. On his return to France he aided in putting down the Jacquerie, and rescued the royal princesses from the rebels by his victory at Meaux. Renewing the ancient feud with the house of Armagnac, he defeated the Count of Armagnac and took possession of Béarn. He was again appointed governor of Languedoc by the king, but on the king's death the regency bestowed that dignity on the Duke of Berry. Gaston defeated him in the battle of Revel, but subsequently renounced his claims. D. in 1391. He was skilled in hunting, and has left a record of his fondness for the chase in his *Miroir de Phébus des déduicts de la chasse, etc.* (Paris, 1507), written in an involved and pompous style. In 1484 the county of Foix became merged in the kingdom of Navarre.—GASTON DE FOIX (*q. v.*), who fell in the battle of Ravenna 1512, was the descendant of a collateral branch. F. M. COLBY.

Fokien, or **Fukien**: See FUH-KIEN.

Foktchany, fok-chaa'nē, or **Fokchani**: a town of Roumania; province of Moldavia, on the Milkow (see map of Turkey, ref. 2–D). It has vineyards and an important trade with Galatz. On Aug. 1, 1789, it was the scene of the victory of the Austrians and Russians under the Prince of Coburg and Suwarrow over the Turks. Pop. 25,290.

Folc-land [O. Eng. *folc*, people + *land*, land]: a term of the Anglo-Saxon laws and institutions, used to designate lands owned by the community at large, and not by individual proprietors—that is, lands the title of which was held by the state, although the possession and usufruct might be temporarily enjoyed by private persons. When the institutions of the ancient German tribes first came within the observation of the Romans land was owned by the community, and this primitive mode of proprietorship was the basis of their tribal polity. The territory of a tribe, being divided into cantons and then into townships (marks), was allotted at regular intervals by the tribal authorities to the individual freemen; such distribution, according to Cæsar, being made annually. Kemble is of the opinion that this common or public land did not embrace all the territory belonging to a tribe, but that the notion of private, absolute proprietorship had already become familiar to the Teutonic peoples. It is certain that at the epoch of the final overthrow of the Western empire this notion was established as a part of their tribal institutions. Upon the barbarian invasions of Gaul, Spain, Italy, etc., the provincial owners were at once deprived wholly or partially of their lands. Of the territory thus seized by the conquerors, a portion was divided in unequal amounts among the warriors and heads of families, who took an absolute property or inheritance in their allotments, and who thus became, according to the nomenclature of the modern law, *allodial* proprietors. The remainder of the territory belonged to the community, and, as a more regular and firm political organization grew up, it was held under the control and at the disposal of the supreme authority—king or assembly of the people. Of this public land a part was appropriated to the uses of the government and to the support of the crown; a part was from time to time granted to allodial proprietors; while another part was bestowed upon individuals, not in absolute ownership, but as benefices to be held in consideration of fealty and services rendered, so that the beneficiaries or tenants enjoyed the usufruct only (*dominium utile*), the ultimate ownership (*dominium directum*) remaining in the state. In respect to the modes of ownership, there thus existed simultaneously among the Teutonic successors to the Western empire three varieties or species of land: (1) the public land, owned by the state and under its immediate control; (2) allodial land; (3) land held by tenure from the state or from some superior lord, to which the name *feudal* was subsequently applied. In the lapse of time, and especially during the periods of internal discord, the allodial mode of proprietorship very generally disappeared, the allodial proprietors finding it for their advantage to voluntarily change their lands into feudal benefices, and by this means to obtain for themselves as vassals, and for their estates, the protection of powerful superior lords.

The foregoing description applies in all its substantial features to the history of land tenures among the Anglo-Saxons in England. Separated at first into a number of petty states, each under the headship of a military chief whose authority in civil affairs was merely nominal, and preserving their ancient forms and modes of local administration in full vigor, they converted the land which they had seized from the Britons partly into allodial estates of inheritance granted to individual freemen, while they retained the greater part as the property of the public, and held it at the disposal of the state. As the former portion was granted to the recipients thereof by means of written charters or deeds, it collectively received the appellation "*boc-land*"; the latter, belonging to the people at large, was appropriately termed "*folc-land.*" "Folc-land" was, then, land the *title* to which was in the community as a whole, but not necessarily that which was actually *possessed* and used in common. While some of it might be suffered to remain in common—and in fact a tract of common land seems always to have been left in every Saxon township, as afterward in every Norman manor—it might also be granted by the state to separate and individual occupants. Such grants, however, could not be for a longer period than the life of the grantee; to confer an inheritance would be to change its nature from folc-land to boc-land. Those who thus obtained temporary possession and usufruct of tracts of folc-land held them subject to heavy burdens. Among these burdens resting upon the occupant were his liabilities to render military service, to contribute to the repair of roads, bridges, and fortifications, to pay various dues to the king, to furnish transportation for public messengers, to furnish provision, horses, and carriages for the king on his travels, and even to provide for the royal hawks, hounds, and horses. Tracts or parcels of folc-land might thus be held by freemen of every degree, noble or not noble, and even by the king himself. An ancient document, preserved from the time of King Alfred, shows that a nobleman owning great estates of boc-land was also possessed of a life interest in certain folc-lands, and these latter he prays the king to continue to his son after his own death.

In addition to these donations or grants, in which the recipient acquired no absolute or inheritable estate, and which did not change its nature, folc-land was the source —or, so to speak, fund—out of which gifts were made in perpetuity to the military or civil servants of the state as rewards or compensation for their services. The tract thus transferred, however, was at once severed from the mass of folc-lands, and passed into the class of boc-lands. If the grant was to a military servant—a thegn—the term "thegn-land" was applied to the portion so conveyed; if to a civil officer, the corresponding designation was "reeve-land" (gerefa-land). Indeed, Kemble supposes that all the territory in a Saxon kingdom was at first considered as folc-land, and that whatever estates of inheritance were held by private persons were derived from this original source; so that every particular case of boc-land had been at some time carved out of the soil once belonging to the people. All boc-land was held by the proprietors under the particular limitations contained in the first charter or grant and under the common burdens imposed by the law. Although there was doubtless some variation in the extent and character of the limitations prescribed to the first grantee, there was a general sameness among them all. The estates were inheritable and alienable, and, although subject to certain common services due to the crown, it is clear that these services were far less onerous than those which were required from tenants during the flourishing periods of the feudal system under the Norman kings. The gifts of the people's land to private persons which have been thus described are intended to embrace also those made to the Church, which obtained in this manner vast quantities of the public domain.

Another use to which the folc-land was put was the maintenance of the crown and the defraying of the public expenses. Income was derived from some portions of it which were granted to life-tenants upon the payment of rents, which were generally, however, products of the soil, and not money. Other portions were retained for the actual use of the crown, in all respects resembling the demesne-lands of a manor occupied, cultivated, and enjoyed by the lord thereof for his personal convenience and benefit. As the royal prerogative increased in strength, these lands came to be regarded as the private property of the king.

Folc-land, being the property of the people as a whole, could not be alienated or changed into boc-land without some act of the government. In the earliest periods of the Saxon commonwealths the "gemote" or general assembly of the nation alone possessed this power. In later times the charters or deeds ran in the name of the king, but still required the assent of his "witan" or council of advisers. As the royal powers increased, and the king came to be regarded as the representative of the state and as embodying in himself the supreme authority, the theory was suggested, and in time was adopted, that the folc-land belonged to him in his official capacity—that it was to be used for his maintenance, and employed by him at his pleasure in rewarding his servants. When this notion was universally accepted the term "folc-land" disappeared from ordinary speech and from the language of all official writings, and that of "*terra regis*" or "crown-lands" was substituted.

From the foregoing sketch it is apparent that the description of folc-land given by many legal text-writers, which makes it synonymous with "common land," or land possessed "in common" or by the common people, is altogether a mistaken one. Sir William Blackstone has fallen into a still graver error in his statement that it was land possessed by the serfs or villeins alone, and therefore belonging, together with themselves, their families, and their effects, to the lord of the soil. For an exhaustive discussion of the subject, with a citation of ancient documents and proofs, the reader is referred to the following authorities: *The Saxons in England*, by John Mitchell Kemble (vol. i., chs. ii. and xi.); *Inquiry into the Rise and Growth of the Royal Prerogative in England*, by John Allen (pp. 129–155); *The Rise and Progress of the English Commonwealth—Anglo-Saxon Period*, by Francis Palgrave (pp. 65–104); *A History of England under the Anglo-Saxon Kings*, translated from the German of Dr. J. M. Lappenberg, by Benjamin Thorpe (vol. ii., pp. 323–326); and *Constitutional History of England*, by W. Stubbs (vol. i.). JOHN NORTON POMEROY.

Földvár: See DUNA FOLDVAR.

Fo'ley, JOHN HENRY, R. A.: sculptor; b. in Dublin, May 24, 1818. His first impulse toward sculpture came from his step-grandfather, who was a sculptor in that city, and he began to study at the age of thirteen. In 1834 he went to London, and entered the Royal Academy as a student. He first exhibited in 1839. He entered in 1844 into the competition for the decoration of the palace at Westminster with statues, and as one of the successful candidates received the commission to make a statue of John Hampden, now in the House of Parliament. The statues of Selden and of Sir Charles Barry in the same building also were from his chisel. In 1856 Foley produced his bronze equestrian portrait-statue of Lord Hardinge for Calcutta; this is counted his finest work. Later he made an equestrian statue of Outram, also in bronze, which added greatly to his reputation. Foley was of a sensitive disposition, and in 1862 he took offense at the way in which his statues were placed at the Royal Academy exhibition, and never afterward would contribute to the exhibition, nor take any advantage whatever of his membership. He made the statue of the Prince Consort and the group of *Asia* for the national memorial to the prince in Hyde Park. Among his other works are statues of Oliver Goldsmith and Edmund Burke for Dublin, and a statue of Father Mathew for Cork. Foley's latest work was a statue in bronze of the Confederate general Stonewall Jackson, a commission from the State of South Carolina. Foley died in London, Aug. 27, 1874. He was buried in St. Paul's Cathedral Sept. 5.

Folger, CHARLES J., LL.D.: jurist; b. in Nantucket, Mass., Apr. 16, 1818; removed to Geneva, N. Y., with his father in 1831; graduated at Hobart College, Geneva, in 1836; admitted to the bar in 1839; judge of the Ontario court of common pleas in 1844, and also master and examiner in chancery; county judge 1851–55; New York State Senator 1861–69; assistant U. S. treasurer at New York 1869; elected associate judge of New York court of appeals 1871; chief judge Nov. 2, 1880; appointed U. S. Secretary of Treasury Nov. 14, 1881, which office he held till his death; nominated by Republican convention Sept. 20, 1882, for Governor of New York, but, because of a defection in his party, was defeated by Grover Cleveland by nearly 200,000 majority. D. Sept. 4, 1884.

Folger, Peter: colonist and writer; b. in England in 1617; removed from Norwich in 1635, and with his father settled at Martha's Vineyard, Mass.; in 1663 removed to Nantucket. His daughter Abia was Benjamin Franklin's mother. From 1673 he was clerk of the courts, and wrote *A Looking-glass for the Times, or the Former Spirit of New England Revived in this Generation* (1675). D. at Nantucket, 1690.

Foligno, fō-leen'yō (Lat. *Fulginium*): town of Central Italy; province of Umbria; 25 miles S. E. of Perugia (see map of Italy, ref. 5–E). It is the seat of a bishopric, and has celebrated manufactures of woolens and parchment. It was known in the Middle Ages as *Fulignum*, and retained its independence until 1281, when it was conquered and destroyed by the Perugians. Rebuilt, it was ruled by the Trinci family until 1439, when it was incorporated with the states of the Church. It was nearly destroyed by an earthquake in 1833. Pop. 8,753.

Folkes, Martin: antiquary; b. in London, England, Oct. 29, 1690; d. there in 1754. He was educated at Clare College, Cambridge, and distinguished himself so much by his mathematical studies that in 1713 he became a fellow of the Royal Society, and in 1741 its president. In 1733 he traveled through France and Italy, and published his *Dissertations on the Weights and Values of Ancient Coins.* His principal work is his *Table of English Gold Coins from the Eighteenth Year of King Edward III., when Gold was first coined in England, to the Present Time, with their Weights and Intrinsic Values*, which was printed in 1745 together with a similar account of the history of silver coinage in England. He contributed papers on Roman antiquities to the *Transactions* of the Royal Society and those of the Society of Antiquaries.

Folkestone: town of England; on the southeast coast of Kent; 83 miles by rail S. E. of London (see map of England, ref. 13–L). It is a favorite watering-place, and its harbor is much frequented by boats used in the mackerel and herring fisheries. Pop. (1891) 23,700.

Folk-etymology, or **Popular Etymology**: that natural and unscientific impression concerning the origin and etymological connection of words which immediately suggests itself to the popular mind without the use of reflection or of reasoning upon consciously collected materials. It is related to scientific etymology somewhat as folk-lore is related to scientific history. Its phenomena are due to an instinctive tendency of the human mind to find meaning and adaptation in the apparently perverse and meaningless material of language. They furnish therefore no guide to the correct etymology of the words concerned, but are, on the contrary, almost invariably misleading, often dangerously so; they do, however, furnish most important clews to the laws of the mind's action, as well as to the scope and relation of the factors of ordinary consciousness. The most commonly recognized cases of folk-etymology are those in which the attempt to "read meaning into" a body of sounds has resulted in a modification of the form of the word. The word has been made to conform to its supposed etymon. Thus (1) a portion of a word may be adapted to the form of an entire word, its supposed etymon; as *causeway* from *causey* (Milton), cf. French *chaussée*, Lat. *calciata* (*via*)—i. e. paved road. Here the syllable *-ey* has been conceived to represent the word *way*, and has been changed accordingly. (2) One of the elements of a compound is readapted to a distincter etymon; as *belfry* for older *berfray* viâ O. Fr. from M. H. Germ. *bercvrit*, watch-tower, in which the former part is connected with Germ. *bergen*, protect; the change of *ber-* to *bel-* is undoubtedly due to the supposed etymon *bell*. So *hangnail* for *agnail* or **angnail*, in which *ang-* represents O. Eng. *ange*, pain; Germ. *beispiel* for *beispel*; *maulwurf* for *moltwurf*, etc. (3) A word of obscure etymology may be changed so as to have a clear etymology, as *touchy* for "vulgar" *tetchy* or *techy*, a derivative of M. Eng. *teche*, *tache*, freak, habit, from O. Fr. *tache*, spot, blemish. Proper names and loan-words, which to the popular ear are generally only arbitrary accumulations of sounds, are peculiarly liable to these corruptions: thus Lat. *Proserpina* (for Gr. *Persephone*); *Agrigentum* (as if *ager* for Gr. *Akragas*); Gr. *Hierosolyma* (as if *hiero-*, sacred) and O. Norse *Iōrsalir* (i. e. horse halls) for the Heb. city-name *Jerushalem*; Mod. Gr. *Anthēna* (for *Athēnai*, Athens) as if the "city of flowers" (*anthos*); *Gotts-chalk* (Germ. *Gottschalk*); *Roths-child* (Germ. *Roth-schild*); *wiseacre* (Germ. *weissager*); not to speak of enormities like *perish* (*Paris*) *green*, *Asiatic* (*acetic*) *acid*, etc.

The false etymological connection may, however, often take place without resultant change of form. It betrays itself then either (1) by the orthography, as *island*, in which the *s* shows a false connection with *isle*; or (2) by the use of the word in its context, as when *incentive* is used as something which inflames (Lat. *incendere*) instead of as something which gives the keynote (Lat. *incinere*), cf. Milton's

Part *incentive* reed
Provide, pernicious with one touch of fire" (*P. L.*, vi., 519);

or (3) in the linguistic consciousness of the individual, as in the use of *cutler* (from Lat. *cultellus*, knife), which most speakers feel to be connected with the verb *to cut*.

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Folk-land and **Boc-land**: See Folc-land.

Folk-lore [*folk*, used in the sense of the Germ. *Volk*, people + *lore* < O. Eng. *lār*: Germ. *Lehre*]: that mass of customs, beliefs, and ideas, possessing a primitive character, which is traditionally communicated from generation to generation. The word, in its stricter sense, is properly applied to the traditions of civilized countries, especially European countries and regions colonized from Europe. By an extension of this signification, however, it is now currently employed in such a manner as to include all material of a similar character, although existing among semi-civilized or uncivilized races; it is common, for example, to speak of Egyptian, Hindu, Aino, or American-Indian folk-lore. This usage seems to be justified by the following considerations: (1) The traditions of Western Europe are connected with those of other continents, and often identical with these; (2) the progress of civilization, even among tribes considered to be in a "primitive" stage of culture, is so rapid that ancestral habits and opinions are rapidly being relegated to the status of superseded notions that constitute folk-lore. Nevertheless, in order to bring the matter within the compass of a general treatment it will be necessary to have in mind, in the first instance, the folk-lore of Europe.

The name originated with W. J. Thoms, who, in writing to *The Athenæum*, Aug. 22, 1846, urging the collection of what in England were designated popular antiquities or popular literature, remarked that the latter "would be most aptly designated by a good Saxon compound 'folk-lore,' the lore of the people." He included under this head manners, customs, observances, superstitions, ballads, and proverbs. The term has not only taken root in English speech, but has become so far naturalized in the Romance languages that it is employed in new formations, as in French *folkloriste*, Italian *folklorico*. The German *Volkskunde*, or information of any kind in regard to a race, is properly a more inclusive term, but is now used as identical with folklore, *Völkerkunde* being reserved for *ethnology*.

The expansion in the meaning has been accompanied by a change in the connotation of the word *folk*. This was defined by the makers of early English dictionaries as signifying *plebs* or *vulgus*, "the common people," and this was the idea it conveyed to the authors who were first to treat of folk-lore, and who had especially in their minds the peasantry of Europe. Under the influence, however, of compounds suggested by the German *Volk*, such as folk-speech, folk-art, folk-music, folk-life, the English word also has shown a tendency to revert to its older sense, as denoting the members of a community united by ties of blood and vicinage. It is also true that the traditions of peasants and uneducated persons do not, in the main, belong to these as a class, but that the illiterate simply retain ideas which once belonged to all classes. Folk-lore is found to exist among the most intelligent as well as among the rudest part of the population; so that *folk*, in this connection, must be taken to include old-fashioned people, and even enlightened minds in so far as these are old-fashioned in their conceptions. By the folk-lore of any particular people, therefore, may be understood the customs and beliefs once proper to the whole race, and now preserved among its less highly educated and consequently more conservative elements.

The compass and character of folk-lore are perhaps best indicated by its external characteristic, namely, in that the traditions of which it consists are transmitted by word of mouth and without the intervention of writing. In oral tradition, from the necessity of the case, individual peculiarities are in a measure eliminated, and the standard is that common to the great majority of the members of the community. With the introduction of the habit of writing the influence of individual ways of thinking becomes greater, and the reading class forms an intellectual aristocracy, among whom ancestral conceptions exist as a survival. In the course of time this reading public so enlarges itself as to become coextensive with the community, which is therefore entirely brought under the influence of superior minds and of exact observations. Corresponding to this change is the substitution of written volumes for the ancient narrations. Thus it is found that with any people in which the use of reading and writing has not become general, there of necessity survives a body of traditions possessing a degree of literary merit, as well as a mass of customs handed down from remote times. With the progress of education, what is characteristic and peculiar yields to what is uniform and cosmopolitan. Isolated persons, unlettered individuals, and children, less under the control of books, preserve this lore for a longer period than others.

According to this view folk-lore, or oral tradition, is the supplement of written literature; folk-lore and literature may be represented as two provinces, which taken together include the whole field of human thought; while over both extend the intersecting circles which mark the territory claimed by different sciences, and which overlap like the various boundary-lines on an historical map.

On the other hand, it must be evident that although oral tradition plays a less important part than formerly, it still can never be entirely superseded; that every generation must have its own folk-lore or characteristic conceptions and usages, which are continually superseded by the introduction of more accurate and intelligent notions as these are formed in superior minds and gradually become universal.

Classification of the Material.—The territory of folk-lore is so extensive, its boundaries so undefined and variable, the survey of the ground so recent and incomplete, and the determination of limits so much a matter of individual preference, that no method of mapping out the field has yet received general recognition, nor perhaps can any system of classification be proposed which will not be found to involve inconsistencies, deficiencies, and cross-divisions. In taking account of the material, it will be well to consider, in the first instance, only civilized Europe and its colonies, thus adopting the narrower signification of the term as above defined. Such matter only need be comprehended as seems to possess an antiquated character, or fulfills the requirement of descending from past generations, and exhibiting the permanence of ancestral habits of thought. For this purpose three sections may be made, corresponding to the categories of action, thought, and expression, under the headings of customs, superstitions, and oral literature.

I. *Customs.*—(*a*) In the first place may be mentioned usages of a ceremonial character, relating to the popular calendar or particular days of the year, such as New Year's Day, Easter, the First of May, All Souls' Day, Christmas; days dedicated to the worship of particular saints; agricultural festivals of sowing and harvest; the celebration of national holidays, as in America the Fourth of July, Thanksgiving, etc. (*b*) *Customs of worship*, consisting of peculiar and local usages connected with established faiths, or religious observances of eccentric sects, household ritual, and individual religious practice. (*c*) *Social customs*, festival gatherings, not determined to precise times of occurrence, like "house-raisings," "bees," and the like; the ritual of secret societies; social etiquette, with its rules of introduction, salutation, leave-taking, etc.; table manners; conditions of service, and rules governing domestic relations; customs of particular families and clans. (*d*) *Customs relative to human life*, in its periods of birth, infancy, puberty, courtship, betrothal, marriage, child-bearing, death; customs of children. (*e*) *Industrial customs*, incident to special occupations, to old-fashioned methods of work, to the holding of fairs and markets, the construction and dedication of houses, launching of ships, etc. (*f*) *Customs of rights and obligations*, communal property and communal jurisdiction, the rules regulating the transaction of business and agriculture, habits of asseveration and obligation, customs of bestowing charities and expecting contributions. (*g*) *Games*, in their many subdivisions; games exhibiting the dramatization of myths and stories, representations of love-making, war, and labor; games intended to test strength and agility, of chance, skill, and wit; guessing games and puzzles; games of children and of nurses. (*h*) *Gestures*, employed to express any of the emotions, appeal, protest, ridicule, etc.

II. *Superstitions.*—Traditions included in this section might, in many cases, be also brought under that which precedes, inasmuch as a superstitious belief is usually accompanied by a custom. The various superstitions form a mass of pseudo-information, the complete examination of which would require a treatise of encyclopædic dimensions. Without any pretense of completeness, superstitions may be divided into those concerning (*a*) *Mythic beings*: fairies, dwarfs, giants, hobgoblins, familiar spirits, and other remains of ancient ethnic belief; angels, saints, and demons, belonging to Christian mythology; ghosts, or souls of the departed; fantastic and imaginary beings, creations of the popular fancy. (*b*) *Times and seasons*: lucky and unlucky days. (*c*) *Objects of nature*: the sun and moon, stars and elements, winds and tempests, ideas exhibiting mythic conceptions; mountains, rocks, and stones, animistically conceived; jewels, with the respective virtues attributed to them. (*d*) *Witchcraft and magic*, in all their varieties and with all their literature; mesmerism, clairvoyance, and the like in so far as these are dependent on traditional error. (*e*) *Divination*: the prediction of the future, whether by direct prophecy or by means of prognostics; astrology, necromancy, geomancy, chiromancy, etc.; popular signs and omens, the tokens used to determine a partner for life; weather-lore and popular meteorology; ordeals and tests; the divining-rod. (*f*) *Popular medicine*, with its history; the doctrine of signatures, belief in the curative power or magic power of human flesh and blood, imaginative methods of cure, faith-healing and mind-cure, so far as these are traditional. (*g*) *Amulets and charms*, their different sorts, descriptions, and effects. (*h*) *Personal*: superstitious beliefs belonging to particular families or individuals. (*i*) *Physiological*: popular ideas of the characteristics of persons belonging to different races, to the connection of mental traits with certain bodily marks, and the like.

III. *Popular Literature.*—A. *Poetry.*—Under this head we have to consider: (*a*) *Popular epics*, of which an example is furnished by the Finnish *Kalevala*, and by Russian popular epics. On the boundaries of folk-lore and literature lie some of the great literary epic poems. (See Epic Poetry.) (*b*) *Ballads*, or narrative songs, so called from their original use in the dance. (See Ballad Poetry.) (*c*) *Carols*, or sacred songs employed in connection with days of the Church, especially Christmas. The word carol is originally identical in meaning with ballad, and may be derived from the Middle Latin *chorea*, although said by etymological dictionaries to be of Celtic extraction. (*d*) *Songs*, especially love-songs. This species of popular literature, current in great abundance in many European countries, is partly represented in English, popular English songs having apparently perished for want of record, although some refrains are preserved. Some of the songs in Shakspeare have something of a popular character. English popular literature entirely lacks the salutations, quatrains, etc., found in Southern Europe.

B. *Prose.*—(*a*) *Sagas* or hero-tales, professing to be historical in character. Familiar examples abound in Norse literature; the heroic literature of Celtic-speaking races has been doubtfully supposed to have been solely of this nature, as exemplified in Old Irish sagas. In English this species of popular composition scarcely exists, owing, no doubt, to the absence of early collection. (*b*) *Märchen*, or fairy tales. This class of composition differs from the former by possessing a less distinctly marked pretense of historical verity, in this respect resembling modern novelettes; yet the distinction is not absolute. The *Märchen* do not belong exclusively to children; on the contrary, the tales of children are generally survivals of those meant for grown folk. (*c*) *Animal Tales.*—In the case of races still in the earlier mythic stage, a considerable part of the mythology consists of such tales; but the animal tales now current in Europe, Asia, Africa, and among the Negroes of America, like the *Märchen*, have no ritual connection. (See Beast-fables.) The passions of man are attributed to beasts, merely in order to justify a moral or turn a jest; these tales, although sometimes of much length, otherwise belong to the category of fables. (*d*) *Legends* are distinguished by their character as sacred histories, relating to a divine being, saint, or holy personage. (*e*) *Drolls*, or jests, are of a humorous nature, being generally broadly comic in their type. (*f*) *Myths.*—The term is often applied to popular narratives belonging to any of the classes named, but in a stricter sense is employed to denote tales professing to give explanations of the existing conditions of beings or things (etiological), or to those assumed to symbolize the operations of nature. (*g*) *Examples*, illustrations, anecdotes.

C. *Minor Elements of Popular Literature.*—(*a*) *Rhymes.*—The designation includes a great variety of forms, game rhymes, nursery rhymes of different sorts, place rhymes, and personal rhymes, what the French call *blason populaire*, etc. (*b*) *Riddles.*—Amusements now regarded as congeners, the conundrum, paronomasia, etc., are not very closely allied to this ancient kind of literature. (*c*) *Proverbs* and sayings. (*d*) *Phrases*, not so distinctly expressive of a general truth. (*e*) *Expressions* and words of a primitive character, when regarded from the point of view of the folk-lore which they contain.

THEORY.—According to the definitions above given, folk-lore makes part of the subject-matter of anthropology, ethnology, psychology, history, æsthetics, ethics, music, and many other sciences. For the purposes of comparative treatment it is impossible to limit examination to the folk-lore of civilized communities, but the traditions of races in a simple stage of culture must also be taken into account. It might seem that the resulting expansion of the material would make it as impossible to deal with the contents of folk-lore as with the contents of literature. There may, however, be a science or theory of folk-lore, considered with reference to its distinguishing characteristics and method of communication. Such an investigation, for which materials are only beginning to exist, might consider, besides a survey and subdivision of the field, the manner of collection of folk-lore; the genuineness of the record; its distribution and diffusion; the different stages and the development of oral tradition; the characteristics belonging to this tradition as inherited and popular; the relation of the ideas of the illiterate to the literate classes; the connection of oral and written literature; the manner in which popular belief and fancy furnish the groundwork for productions of art, and the reaction of conscious art on tradition; the connection of superstition with philosophy and poetry; and numerous similar topics. In regard to such questions, which require extended treatment, only a few remarks can here be offered.

(*a*) *The Recording of Folk-lore.*—It is now considered as essential that a popular tradition, in order to become the material of scientific consideration, should be written down exactly as repeated to the collector, without addition or adornment. Such, however, was by no means the practice of early collectors, who regarded folk-lore as mere curiosities which were interesting only when singular, and which required to be ornamented and corrected before being committed to print. For example, the early gatherers of English ballads had no hesitation in adding an introduction or conclusion to their material, or in reconstructing any irregular stanza or quaint idiom. The imperfect understanding of the true characteristics of oral tradition caused collectors of tales, even when of distinguished scientific attainments, to include pieces not really of a popular character. As these productions were highly estimated according to literary merit, the temptation was irresistible to edit the ruder stories in such manner as to give them an attractive dress, and this practice of beautifying folk-tales has continued down to the present time. To this erroneous procedure has been added, in many cases, absolute forgery; the literary conscience of the past generation scarcely considered invention in this field as anything more than a justifiable effort of ingenuity. A particularly flagrant example of this artificial production of traditions was furnished by Hersart de la Villemarqué, whose Breton collections are now known to have been in great part fictitious. Even at the present moment this method of creating folk-lore has by no means ceased, but, in part from miscomprehension and mistaken theory, in part from deliberate imagination, myths and stories which have no real existence on the lips of any folk continue to be added to the stock. Such inaccuracy renders necessary particular caution, both in the recorder and in the critic of traditional material. These remarks apply also to a great part of the information to be found in books respecting the mythology and customs of primitive races, and affect the validity of the general conclusions constantly founded on imperfect testimony and appearing in general treatises on the theory of religions, mythologies, and ethical notions.

(*b*) *Folk-lore and Anthropology.*—The popular traditions of civilized countries may be considered from either of two different points of view. The products of oral tradition may be estimated according to their value as literature, and judged according to the rules of æsthetics, or else they may be viewed especially as survivals of earlier conditions of culture, and as calculated to throw light on the progress of history and the development of intelligence. As the latter method is the more inclusive, and as a consideration of folk-lore as science is not incompatible with a just estimate of its interest as literature, the material is usually regarded as coming within the province of anthropology. With regard to the definition and limits of the latter science, no agreement exists, some investigators being disposed to limit the inclusiveness of the term to the study of man regarded as an animal, or to the review of the characters of uncivilized man, while others, apparently in the majority, take in the whole field of human action, and include those general questions which formerly were considered to form the province of philosophy. Ethnography consists in the description of the characters of a race or of the races of a certain territory; ethnology in the corresponding theoretical inquiries. The folk-lore of any given country would therefore form part of the ethnography of that country; but as it will be shown that race is a secondary question in regard to folk-lore, and as the comparative subject may be viewed from a general human point of view, it must be under general anthropology, rather than ethnology, that folk-lore should be brought.

(*c*) *The Antiquity of Folk-lore.*—The persistence of oral tradition and tenacity of the popular memory are often the subject of remark, and might be illustrated by numerous examples. Certain games are as old as history, and in some cases even the formulas with which they are played may be traced for 2,000 years. The elements of folk-tales also, or some portion of them, seem to be prehistoric in date. In recent collections of ballads in Scandinavian countries it was found that many of these had changed only in language or in reduction of compass from the forms collected in manuscript three centuries before. Some modern spells and superstitions also have been shown to be nearly identical with similar matter recorded more than a thousand years ago. Observations of this sort have led to extravagant assertions regarding the antiquity of all popular traditions. It is certain, however, that no such general principle can be established. If some traditions are ancient, others are modern. There is constantly going on a change in the fashions of popular tradition, although the alteration is much slower than in the case of literature. The question of the probable date of a usage or story can not be answered in any universal manner, but must in each separate case be a theme of inquiry.

(*d*) *Folk-lore, Race, and Language.*—The questions which have been most eagerly debated, and on which most difference of opinion continues to exist, are those which affect the diffusion and distribution of folk-lore. To Jacob and William Grimm, and other students of the early part of the century, tradition, descent, and linguistic form were parallel. The doctrine of these scholars was that the mythology of each particular race expressed the special way of considering nature proper to that branch of the human family, and that this information was traditionally handed down unmingled as a sacred treasure to descendants; this inherited stock of knowledge, though affected by the influences of time, survived in the oral tradition of the later age; thus folk-lore, as the remainder of what was especially national, indicated the true way of feeling proper to a folk, and thus collection and study went hand in hand with patriotic feeling. After comparative philology had established the kinship of Indo-European tongues and undertaken to reconstruct the civilization of the original stock, by means of linguistic comparisons, the principle continued to be held that community of popular tradition was proof of common descent. This view, expressed in the phrase "Aryan origins," played a great part in the speculations of Max Müller and other writers. In this method of research, however, ethnology and archæology had not been consulted. The results of recent investigation have been to cast into uncertainty results which were supposed to be secure; the original habitat of the Aryan race, formerly established in Asia, has been variously fixed in Southern Europe and North Africa; the physiological characteristics of the peoples in question have been shown to be so mixed that at the present time no certain opinion can be maintained regarding their original racial characters. Corresponding to this debate, comparisons of the material of folk-lore have shown that race is a very secondary element in tradition, and that language itself is no certain guide. Thus the Basques of Europe appear entirely to lack any characteristic folk-lore; Finns have adopted many traditions from their Swedish neighbors: Bretons have altogether forgotten the legends and sagas, which in the Middle Ages must presumably still have existed, in favor of notions imported from more cultivated France. It has been established that Europe and Asia, from Ireland to Japan, form an area of communication throughout which has been diffused a folk-lore in some respects corresponding. Similar conclusions are indicated in regard to other continents—Africa, Australia, and America. It appears, therefore, that the influence of one race on another depends chiefly on contiguity, and that such intercommunication is not solely a product of civilization, but has existed from the most remote times. Although promoted by alliance of religious belief and sympathy of trade relations, this process of diffusion goes on even between races which cordially hate each other, and which are at war with each other. The tendency of modern inquiry, therefore, is to reverse the older way of thinking, and to regard race and language as secondary factors in determining the prevalence of popular traditions. This remark, however, applies only to the story, or to the outline of the narrative; in the decoration and linguistic form the character of the race appears; the story is so reconstructed as to become illustrative of the ideas and customs of the region, and in this manner may be no less valuable for ethnological purposes than if it had in the first instance been the reflection of the habits of the tribe which recites it. Such, at least, seems to be the conclusion to which comparative investigation is tending. This conclusion, however, is not matter of universal assent. Some writers, especially in Great Britain, insist that folk-lore may prove serviceable in tracking out remote ethnic relationships, while others have hitherto been inclined to explain resemblances in belief and practice as independent inventions, indicating not counteraction, but only the natural products of corresponding stages of culture. It must be said, however, that the observable relation does not admit of the indefinite extension of this theory. On the other hand, it must be allowed that general parallelisms prove nothing in regard to interchange; and such seems at present to be the character of the parallelism of American and Asiatic tradition; while it appears certain that there has been some effect of Asiatic influence on the ideas of American aborigines, it is not established that this connection is other than secondary and relatively unimportant. See F. Boas, *Dissemination of Tales among the Natives of North America*, *Journal of American Folk-Lore* (1891).

(*e*) *Oral and Written Composition.*—A series of difficult questions, to which it is only necessary to allude, arise as to the relations of these two sorts of composition. It has been doubted whether the inventors and repeaters of popular traditions use conscious art in the same manner as do writers with the pen, or whether these productions arose with deliberate invention by the process of repetition from lip to lip. It has also been held that some part, at least of folk-narratives, are based on literary antecedents. On the other hand, it is urged that many of the great productions of genius are based on popular imagination, the author employing and reconstructing traditions contained in the folk-lore of his land. The whole theory of the relation between the written literatures of advanced civilizations and the literary creations of races not in the habit of recording their knowledge is a subject which can not be dealt with in a satisfactory manner until there exist fuller and more accurate collections of the myths, tales, and songs of uncivilized races than those which have hitherto been at the disposal of the student.

BIBLIOGRAPHY.—All that can be done here is to note a few works of a general character, leaving the bibliographic information proper to each division to appear in its proper place.

(*a*) Question-books or *questionnaires*: *The Handbook of Folklore*, edited by G. L. Gomme (London, 1890); *Questionnaire de Folklore*, publié par la Société du Folklore Wallon (Liège, 1891); P. Sébillot, *Essai de Questionnaire* (Paris, 1889); A. Gittée, *Vraagboek tot het Zamelen van vlaamsche Folklore of Volkskunde* (Ghent, 1888); *Topics for Collection of Folk-Lore*, F. D. Bergen and W. W. Newell (*Journal of American Folk-Lore*, 1890).

(*b*) Journals: *Folk-Lore* (London, established in 1890), continuing the *Folk-Lore Record* (1878), and the *Folk-Lore Journal* (1883), all published by the Folk-Lore Society; *Revue des Traditions Populaires* (Paris, 1886); *Journal of American Folk-Lore* (Boston, 1888); *Zeitschrift des Vereins für Volkskunde* (Berlin, 1890); *Ethnologische Mitteilungen aus Ungarn* (Budapest, 1889), published by the Gesellschaft für die Völkerkunde Ungarns, and continuing the work of the *Journal of the Gypsy Folk-Lore Society* (London, 1889–92). Among other periodicals are to be especially named the following: *Mélusine* (ed. A. Gaidoz, Paris, 1877); *Wallonia* (ed. O. Colson and others, Liège, 1893); *Am Ur-Quell* (ed. F. S. Krauss, Vienna, 1890); *Archivio per lo Studio delle Tradizioni Popolari* (ed. G. Pitrè, Palermo, 1882); *Český Lid* (ed. L. Niederle, Prague, 1892); *Wisla* (ed. J. Karlowicz, Warsaw, 1887); *Zhivaya Starina* (ed. J. Lamanski, St. Petersburg, 1890); *Indian Antiquary* (Bombay, 1892); American anthropological journals are: *The American Anthropologist* (Washington); and *The American Antiquarian and Oriental Journal* (Good Hope, Ill.).

(*c*) General works: There is no general introduction to the study of folk-lore. The beginner will find a series of suggestive papers in *The International Folk-Lore Congress, Papers and Transactions* (London, 1892). For the relation between folk-lore, ethnic custom, and mythology, see W. Mannhardt, *Die Korndämonen* (Berlin, 1868); *Wald- und Feldculte* (Berlin, 1876); *Mythologische Forschungen* (Berlin, 1888); J. G. Frazer, *The Golden Bough, a Study in Comparative Religion* (London, 1890); A. Lang, *Custom and Myth* (London, 1884) and *Myth, Ritual, and Religion* (London, 1887); G. L. Gomme, *Folk-Lore Relics of Early Village Life* (London, 1888) and *Ethnology in Folk-Lore* (London, 1892).

For ballads the student may refer to the work of F. J. Child, *The English and Scottish Popular Ballads* (Boston, 1882–93); for tales, to E. Cosquin, *Contes populaires de Lorraine comparés*, etc. (2 vols., Paris, 1885); T. F. Crane's *Italian Popular Tales*, with notes (Boston, 1885); W. A. Clouston, *Popular Tales and Fictions, their Migrations and Transformations* (2 vols., Edinburgh, 1887); J. Jacobs, *Æsopus* (2 vols., London, 1889); E. Sidney Hartland, *The Science of Fairy Tales* (London, 1891).

For popular festivals and the calendar, see W. Hone, *The Every-Day Book* (London, 1826); *The Table Book* (1827); *The Year Book* (1829, and several times reprinted); R. Chambers, *Book of Days* (Edinburgh, 1863).

(*d*) English collections: J. Brand, *Popular Antiquities of Great Britain*, arranged by H. Ellis (2 vols., London, 1813), with additions by W. Carew Hazlitt (3 vols., London, 1870); C. S. Burne, *Shropshire Folk-Lore* (London, 1886); R. Chambers, *Popular Rhymes of Scotland*; W. Gregor, *Notes on the Folk-Lore on the Northeast of Scotland* (London, 1881); J. O. Halliwell-Phillips, *Popular Rhymes and Nursery Tales* (London, 1849); J. Harland and T. Wilkinson, *Lancashire Folk-Lore* (London, 1867); W. Henderson, *Notes on the Folk-Lore of the Northern Counties of England and the Borders* (London, 1866); R. Hunt, *Popular Romances of the West of England, or the Drolls, Traditions, and Superstitions of Old Cornwall* (London, 1865; 2d ed. 1878); J. Napier, *Folk-Lore, or Superstitious Beliefs in the West of Scotland* (Paisley, 1879). The Irish literature is inadequate; as examples, in addition to collections of ballads and tales, may be mentioned Lady Wilde, *Ancient Legends, Mystical Charms, and Superstitions of Ireland* (2 vols., Boston, 1867); J. Mooney, *The Funeral Customs of Ireland*, in *Proceedings* of the American Philosophical Society (1888). For American aboriginal folk-lore, see INDIANS. See also GAMES, EXEMPLA-BOOKS, LEGENDS, MYTHOLOGY, and SONGS.

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Folk-tales: the title given to narratives of whatever description which are orally current, not having been composed with the pen, but communicated by way of recitation and repeated by word of mouth. From this method of transmission it results that the compositions in question reflect the average intelligence rather than that of a superior literary class; furthermore, that they possess, for the most part, a considerable antiquity, and represent the conceptions, not of recent civilization, but of a much earlier period. The different classes of these tales have been enumerated in classifying the material of FOLK-LORE (*q. v.*). See also *The Dissemination of Tales among the Natives of North America*, by F. Boas.

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Fol'len, CHARLES THEODORE CHRISTIAN, Ph. D., LL. D.: writer, reformer, and liberal preacher; b. at Romrod, in Hesse-Darmstadt, Sept. 4, 1796; educated at Giessen. His patriotic sympathies soon got him into trouble. He was several times arrested, and after fleeing from Giessen he went to Switzerland. He was appointed Professor of Latin and History in the cantonal school at Chur (Coire); but being a liberal in theology as well as in politics, his lectures gave offense to the Calvinistic ministers; so that, finding his position uncomfortable, he resigned it and left. Next he lectured on law and metaphysics at Basel, but his reputation went with him; the allied powers demanded his surrender, and again he fled, this time through Paris to Havre, whence he embarked for the U. S., where, thanks to influential friends—La Fayette among them—he found welcome. A few months after he landed, in the autumn of 1825, he was made tutor of German at Harvard College. Three years later, having in the meanwhile studied divinity with Dr. Channing, and been admitted to the Unitarian ministry, he was appointed Professor of Ecclesiastical History and Ethics in the Cambridge Divinity School; in 1830 the professorship of German Language and Literature was conferred on him. In the five years he held it he did much to make that department attractive. For a short time (1836–37) he was pastor of the First Unitarian church in New York, following Rev. William Ware. His freedom of speech about slavery cut short his ministry there, and in 1839 he accepted a call to East Lexington, Mass., where he had hardly established himself when he was lost in the steamer Lexington, which was burned on Long Island Sound, Jan. 13, 1840. His writings, with memoir, were published in five volumes at Boston in 1841.

Follen, Eliza Lee: wife of Charles Theodore Christian Follen; daughter of Samuel Cabot; b. in Boston, Aug. 15, 1787. She, like her husband, whom she married in 1828, was an earnest abolitionist from first to last, and a diligent writer. Her *Selections from Fénelon*, *Well-spent Hours*, and *Married Life*, exerted wholesome influence in their time. The memoir of her husband was from her pen. *The Child's Friend* was under her editorship from 1843 to 1850. D. in Brookline, Mass., Jan. 26, 1860.

Folly Island: an island of South Carolina; in Charleston co.; extends S. W. from Lighthouse Inlet to Stone river, having Folly Island river on the northwest and the ocean on the southeast. It is in part heavily timbered, and was the scene of important operations during the civil war.

Folsom, George, LL. D.: antiquary; b. in Kennebunk, Me., May 23, 1802; graduated at Harvard College in 1822, and studied law. In 1830 he published a *History of Saco and Biddeford, Me.*; in 1837 removed to New York and became a member and librarian of the New York Historical Society; in 1841 edited a volume of its *Collections*; afterward translated the *Dispatches of Hernando Cortés*; in 1843 published the *Political Condition of Mexico*; in 1858 *Documents Relating to the Early History of Maine*. He was a member of the New York State Senate in 1844–48, and *chargé d'affaires* to the Netherlands 1850–54. Mr. Folsom was president of the American Ethnological Society. D. in Rome, Italy, Mar. 27, 1869.

Folsom, Joseph L.: soldier; b. in Meredith, N. H., May 19, 1817; graduate of the U. S. Military Academy, and brevet second lieutenant of infantry July 1, 1840; served in Florida against the Indians, and on the Northern frontier 1840–44; transferred to the quartermaster's department, with rank of captain, Sept. 1, 1846, and served in California during the war with Mexico. He was among the first to appreciate the discovery of gold in California, and communicate the information officially to his Government. He was identified with the early history and development of San Francisco, where he became a large property-owner. Folsom City, on the American river, near the locality where gold was discovered, is named in his honor. D. at San José, Cal., July 19, 1855.

Folsom, Nathaniel: soldier; b. at Exeter, N. H., in 1726; commanded a company at Fort Edward in 1755, and aided in the capture of Baron Dieskau. Commanded a regiment of militia before the Revolution, and as brigadier-general of the New Hampshire forces served in the siege of Boston until July, 1775. Was a member of the Continental Congress 1774–75 and 1777–80; councilor in 1778; and president of the convention which framed the constitution of New Hampshire in 1783. D. at Exeter, May, 26, 1790.

Folsom, Nathaniel Smith: clergyman; b. at Portsmouth, N. H., Mar. 12, 1806; graduated at Dartmouth College 1828, and at Andover (Mass.) Theological Seminary in 1831; ordained at Bradford, Mass., 1831; was missionary in Liberty co., Ga., in 1831–32; was professor in Lane Seminary and in Western Reserve College from 1833 to 1836; was pastor of the Congregational church at Francestown, N. H., from Oct. 12, 1836, to Aug. 21, 1838; then of a church at Providence, R. I., 1838–40; of a Unitarian church at Haverhill, Mass., 1840–46; edited *The Christian Register* 1846–48 at Charlestown, Mass.; and was Professor of Literature and Biblical Interpretation at Meadville Theological School, Pennsylvania, from 1848 to 1861. He took up his residence in Boston in 1875. He published an address on temperance (1839), and an *Interpretation of the Prophecies of Daniel* (1842), but his most important work was a *Translation of the Four Gospels* (revised edition 1885). D. Nov. 10, 1890.

Folwell, William Watts, LL. D.: b. at Romulus, Seneca co., N. Y., Feb. 14, 1833; graduated at Hobart College 1857; was teacher in Ovid Academy two years, then became adjunct Professor of Mathematics in Hobart College; in 1860 and 1861 studied philology in Berlin and traveled extensively in Europe; in Jan., 1862, was commissioned first lieutenant in the U. S. Engineers, with which command he served through all the campaigns of the Army of the Potomac till the close of the civil war, attaining the actual rank of major of engineers and the brevet rank of lieutenant-colonel U. S. Vols. After some years spent in business he became in 1869 Professor of Mathematics in Kenyon College, Gambier, O., and later in the same year was elected president of the University of Minnesota, and afterward Professor of Political Economy there and librarian. He has published *Public Instruction in Minnesota*, in the *Transactions* of the National Educational Association (1875), and *Lectures on Political Economy*.

Folz, or **Folcz**, Hans: poet; b. at Worms in 1478; became a resident of Nuremberg and a Protestant; was by profession a barber. He was one of the most noteworthy of the German mastersingers, and besides mastersong wrote dramatic Shrovetide pieces and rhyming tales. His lyrics are often spirited, graceful, and of high moral tone and much literary merit; but his other writings are often marked by needless coarseness and a roughly vigorous style of humor.

Fomentation [viâ Fr. from Lat. *fomenta'tio*, deriv. of *fomenta're*, foment, apply warm lotions, deriv. of *fomentum*, **fovimentum*, foment, warm lotion, deriv. of *fove're*, warm, keep warm]: in therapeutics, the application of hot epithems, wet or dry (wet fomentation, dry fomentation), to diseased parts. Fomentations act chiefly by the heat and moisture they convey to the surface treated, but they are sometimes medicated. Fomentation is usually a safe, and often an effective, means of treating many diseases.

Fomites, fom'ĭ-tēez [Lat., plur. of *fomes*, kindling-wood, tinder, deriv. of *fove're*, to warm]: in sanitary science, objects, such as clothing, furniture, bedding, wall-paper, etc., by which the infection of certain diseases is retained, and by which disease may be propagated.

Fonblanque, fōn̄'blaȧnk', Albany William: journalist; b. in London, England, in 1797; the son of John de Grenier Fonblanque (1759–1837), a famous equity lawyer, and a brother of John Samuel Martin Fonblanque (1787–1865), an able writer on law reform. Mr. Fonblanque was (1820–46) editor of *The Examiner*, and was distinguished for literary abilities and for his useful labors as a publicist. He was (1846–72) chief of the statistical department of the Board of Trade, and comptroller of the corn returns. D. in London, Oct. 14, 1872. His *England under Seven Administrations* (1837) is a valuable collection of articles from *The Examiner*. See *Life and Labors of Albany Fonblanque*, by his nephew, Edward Barrington de Fonblanque, 1874.

Fonda: village and railway junction; capital of Montgomery co., N. Y. (for location of county, see map of New York, ref. 4–I); on the Mohawk river; 42 miles N. W. of Albany. It has knitting-mills and manufactures of flour and carriages. Principal business, farming and dairying. Pop. (1880) 944; (1890) 1,190; (1900) 1,145.

Fond du Lac: city and railway center; capital of Fond du Lac co., Wis. (for location of county, see map of Wisconsin, ref. 6–E); on Lake Winnebago, at the mouth of Fond du Lac river; 148 miles from Chicago, 63 from Milwaukee, 65 from Green Bay, and 43 from Sheboygan, thus enjoying the advantages of four competing lake-ports. The city is well built, and is delightfully situated on a plain surrounded by hills and groves. It has a public library, several public gardens for out-door amusements, manufactures of lumber, agricultural machinery, cars, paper, etc., and an important trade in grain, lumber, and pork. Water is supplied by the Holly system from artesian wells, the mineral properties of which have made them famous. Pop. (1880) 13,094; (1890) 12,024; (1900) 15,110. EDITOR OF "REPORTER."

Fonseca, fōn-sā'kaă, BAY OF (also called GULF OF CONCHAGUA): an inlet of the Pacific Ocean; in the southwest coast of Central America; between Salvador on the W., Honduras on the N. E., and Nicaragua on the S. E. The mouth is 22 miles wide between two opposing points, and is divided by islands into four channels, all of which admit large vessels; within the bay broadens to 44 miles from N. W. to S. E. by 19 miles from N. E. to S. W. It contains several islands, and there are a number of good ports on the coast, the bay itself forming a large and secure harbor. The tides average over 10 feet. The volcano of Coseguina occupies the point on the southern side of the entrance to the bay.

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Fonseca, JUAN RODRIGUEZ, de: Spanish ecclesiastic and administrator; b. in Toro, near Seville, 1451. He was successively Archdeacon of Seville, Bishop of Badajoz, Palencia, and Conde, Archbishop of Rosario in Italy, and finally Bishop of Burgos, besides being head chaplain of Queen Isabella and afterward of King Ferdinand. In 1493 he was appointed to superintend preparations for the second voyage of Columbus, and thereafter he had chief control of all matters relating to the New World until the death of Ferdinand in 1516; he directed the Casa de Contratación, or Council of Seville, and was the first head of the COUNCIL OF THE INDIES (*q. v.*), organized in 1511. Columbus quarreled with him almost from the first, and Fonseca's influence was constantly exerted against him and his family; he also schemed against Cortés, and opposed the reforms of Las Casas. Probably his malignity has been exaggerated by Irving and others, but it is certain that he did much harm. Under Ximines he was disgraced, but regained his influence some years later, and was predominant in the Indian council until his death, which occurred at Burgos, Nov. 4, 1524.

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Fonseca, MANUEL DEODORO, da: Brazilian soldier and politician; b. in the province of Alagoas, Aug. 5, 1827; entered the army as a cadet in 1843; subsequently studied in the military school, and graduated in 1849 with the rank of sub-lieutenant of artillery. In the Paraguayan war, 1868–70, he served as colonel; later he was military commandant of various provinces, and attained the rank of major-general. During this period he was a conservative, and personally attached to the Emperor Dom Pedro II.; but in 1887 he and other military leaders opposed certain acts of the Government, and were punished for insubordination. The malcontents eventually brought about a mutiny, deposed and banished the emperor (Nov. 15, 1889), proclaimed a republic, and made Fonseca chief of the provisional government. The republic was recognized by the U. S., and later by France, Great Britain, and other European countries. A constituent assembly met on Jan. 20, 1891; the constitution proposed by Fonseca and his colleagues was adopted, and Fonseca was elected president for four years with the military title of marshal (Feb. 24, 1891). On the meeting of the first legislative congress (June 15, 1891) opposition to the Government took a serious form, and revolts broke out in various places. President Fonseca finally dissolved the congress (Nov. 4, 1891), and proclaimed a state of siege; but disorders continued, and the state of Rio Grande do Sul virtually seceded. Fonseca was accused of arbitrary acts, and on Nov. 23 was forced to resign, the vice-president, Peixoto, taking his place. He remained at Rio de Janeiro, where he died Aug. 23, 1892. HERBERT H. SMITH.

Fonseca, PEDRO, da, D. D.: "the Portuguese Aristotle"; b. at Costizada in 1528; became a Jesuit in 1548; held professorships at Coimbra and Evora; resided at Rome 1572–79; was the instructor of Molina; wrote commentaries on Aristotle (4 vols., 1572–1602); *Institutiones Dialecticæ* (1564); and a treatise on foreknowledge and free will (1588). D. at Lisbon, Nov. 4, 1599.

Font [M. Eng. *font, fant* < O. Eng. *fant*, from Mediæv. Lat. *fons, fontis*, font < Lat. *fons*, spring, fountain]: a cistern or vessel used in churches to contain the baptismal water. It is usually of stone, frequently porphyry, or other rich marbles. It was permitted by the Council of Lerida (A. D. 524), that if the priest could not procure a stone font he might provide himself with a *vas conveniens ad baptizandi officium* of any material (Labbe, *Concil. IV.*, 1615), which was not to be used for ordinary purposes, but reserved for the sacrament alone (Leo IV., *de Cura Pastoral.*; Labbe, *Concil. VIII.*, 37). In the Eastern Church the font was usually of metal or wood, and seldom or never possessed any special beauty or adornment (Neale, *Eastern Church*, i., 214).

The proper place for the font was at the entrance of the church building, symbolizing baptism as the "door" of the Church. The usual form was octagonal, with a mystical reference to the eighth day as the day of our Lord's resurrection, and of regeneration by the Spirit (cf. Ambros, *Epist.* 20, 44, quoted in Smith and Cheetham's *Dict. Christ. Antiq.*, i., 680). The font is frequently fashioned with much taste and skill. The most detailed description of a baptismal font is that given in the life of St. Sylvester, in the *Bibl. Pap.* of the pseudo-Anastasius (sec. 37); vide Smith and Cheetham, *Dict. Christ. Antiq.* This font is said to have been presented by Constantine the Great to the Church of the Lateran. The cistern is stated to have been made of porphyry, overlaid within and without with silver. In the middle of the font were two pillars of porphyry supporting a golden dish, in which was the Paschal lamp. A golden lamb and seven silver stags (cf. Psalm xlii. 2) poured out water, and on either side of the lamb were silver statues of Christ and John the Baptizer. The oldest fonts existing date from the eleventh century, but, though full information on the subject is lacking, it is evident that the font has undergone various changes of form as the rite of baptism changed. It is believed that the use of "standing fonts" began with the practice of infant baptism, and the substitution of aspersion for immersion in the sacrament, perhaps in the Middle Ages. In the old baptisteries—often buildings entirely separated from the church proper, and used exclusively for the performance of baptism—the font was often a large basin approached by descending steps, indicating that in those days baptism was most generally administered by immersion. At the time of the Reformation the fonts were generally much larger than those made now; they were, indeed, made so large that an infant could be baptized in them by immersion, as is shown by a glass picture from that time. The name *font* is often incorrectly applied to the stoup, stock, or *bénitier*, a vessel containing holy water and placed near the entrance of Roman Catholic churches. See Simpson, *Series of Ancient Baptismal Fonts*, and Paley, *Ancient Fonts*.

Revised by WILLIAM STEVENS PERRY.

Fontaine, fōṅ'tān', PIERRE FRANÇOIS LOUIS: architect; b. at Pontoise, France, Sept. 20, 1762; practiced during the whole period from the first republic to the second empire, mostly in partnership with his fellow-pupil, Percier. Among his works may be mentioned extensive alterations of the court and staircases of the old Louvre; plans for uniting the Tuileries to the Louvre; the Arc de Triomphe du Carrousel (1807); the Chapelle Expiatoire for Louis XVIII. (1815–20); the Chapelle St. Ferdinand, memorial to Duke of Orleans (1843); besides several literary works, especially *Choix des plus célèbres maisons de plaisance de Rome* (1809–24) and *Recueil de Décorations Intérieures* (1812); officer of the Legion of Honor in 1814, commander 1832; and for many years president of the Conseil des Bâtiments Civils. His work, especially in furniture and decoration, displays great refinement of taste. D. in Paris, Oct. 10, 1853. A. D. F. HAMLIN.

Fontainebleau, fōṅ'tān-blō': town of France; department of Seine-et-Marne; 35 miles S. E. of Paris (see map of France, ref. 3–F). Its palace, built in the twelfth century and enlarged and embellished in each succeeding century, is one of the most magnificent buildings in France. The forest which surrounds it, and which is wholly laid out as a landscape-garden, comprises 64 sq. miles, and the roofing of the palace covers no less than 14 acres. The present structure was begun by Francis I., who employed Leonardo da Vinci, Andrea del Sarto, and Benvenuto Cellini to complete and execute his plans. By Henry IV. the building was much enlarged. He added the Diana Gallery, the Court of the Princes, and the Galerie des Cerfs. The later Bourbons disliked the place, and suffered it to be neglected, but it was again restored with great magnificence by Napoleon I., who spent 6,000,000 francs for the purpose. Some of the most pathetic incidents in his life occurred here. The first of the five great courts still bears the name in popular parlance of the Court of Adieux, as it was there Napoleon bade farewell to the Old Guard. The town is neat and well built. It has some trade in wine, grapes, garden-produce, etc., and some manufactures of porcelain and earthenware. Pop. (1896) 14,078.

Fontana, fon-taa'naă, DOMENICO: Italian architect; b. at Como in 1543; studied architecture at Rome. Cardinal Montalto, afterward Sixtus V., commissioned him to build a chapel in Santa Maria Maggiore for him, but the expense being above his means the chapel was not finished till the cardinal became pope and Fontana was appointed pontifical architect. The difficulty of raising the obelisk on the piazza of St. Peter was solved by Fontana, who received high honors as well as liberal pay. After this Fontana was commissioned to raise three other obelisks—that of the mausoleum of Augustus, which was placed on the piazza of Santa Maria Maggiore; another before the basilica of St. John Lateran; the other on the piazza before Santa Maria del Popolo. He then added a portico of travertine to the façade of St. John Lateran, and built a splendid palace of three stories for the pope, and began the Vatican library finished under Clement VIII. Fontana also continued the pontifical palace of the Quirinal, and transported from the baths of Diocletian the two colossal groups of demigods with horses which stand before it. He fell into disgrace while constructing a bridge in the quarter of the city called Borghetti, having been accused of misappropriating money confided to him for this purpose. The pope, judging him to be guilty, dismissed him. Count Miranda, Viceroy of Naples, then offered him the post of architect and first engineer to the King of the Two Sicilies, and Fontana went to Naples about the year 1592 with his wife. There he constructed several canals, protecting the province of the Terra di Lavoro from inundations, and the royal palace, which is marred by the additions of later architects. He made designs for the port of Naples and a pier. He was greater as engineer than as architect. D. at Naples in 1607. W. J. STILLMAN.

Fontana, GIOVANNI: architect; elder brother of Domenico Fontana, and his assistant in several enterprises; was especially successful as a hydraulic engineer and designer of fountains. D. 1614.—CARLO, perhaps related to Giovanni, b. 1634; d. 1714; assisted Bernini in several works; designed the Palazzo Torlonia and many other works, none of first-rate importance. A. D. F. HAMLIN.

Fontanel' [from Fr. *fontanelle*, fontanel, dimin. of *fontaine*, fountain]: the soft palpitating spot upon the head of a young infant; so called because its throbbing was likened to the welling up of a fountain. The fontanels are usually from four to six in number, but only one or two are easily detected in most cases. The great fontanel is at the crossing of the coronal and sagittal sutures. It is generally closed by the development of the neighboring bones within two years after birth. The smaller posterior or bregmatic fontanel is at the junction of the sagittal with the lambdoidal suture, and closes in a few months after birth. There are also two sphenoidal and two mastoidal or Gasserian fontanels, but they are very small, and generally close soon after birth. The two principal fontanels are of great importance in midwifery, as they enable the skillful practitioner to determine the position of the fœtus in head presentations.

FONTANEL is also a small issue or artificial ulcer made by the surgeon for its derivative effect. A common dried pea, a lump of beeswax, or other hard mass is kept in a small cut under the skin, causing a flow of pus. The fontanel, though a valuable therapeutic means, is not much employed.

Fontanel'la, FRANCESCO: Italian educator and author; b. at Venice, June 28, 1768; became a priest, and was for a time Professor of Grammar in Venice, and afterward Professor of Latin Eloquence at Udine, but his principal employment was proof-reading. He was author of Greek and Hebrew grammars and lexicons, and of several learned philological treatises. D. at Venice, Mar. 22, 1827.

Fontanes, fon'taan', LOUIS, Marquis de: poet and politician; b. at Niort, France, Mar. 6, 1757; went to Paris in 1777 and in the following year published *La Fôret de Navarre*. This was followed by several other poetical works of merit, among which may be mentioned a translation of Pope's *Essay on Man* (1783), *La Chartreuse de Paris*, *Le Jour des Morts dans une Campagne*, the latter a poem in the style of Gray's *Elegy*, and *L'Épitre sur l'Édit en faveur de non-Catholiques*, which was crowned by the Academy in 1789. In the early period of the Revolution he edited the *Modérateur*, and opposed the growing spirit of anarchy. Having retired to Lyons after the death of the king he dared to present to the convention an eloquent appeal on behalf of the city, for which he was proscribed, but he escaped by flight. He remained in hiding till after the fall of Robespierre, when he once more became prominent in Paris, but an article in the *Mémorial*, of which he was an associate editor, displeased the Government, and he was again obliged to flee. He found a refuge in London, where he became a close friend of Chateaubriand, also an exile. Returning after the *coup d'état* of 1799 (18th and 19th Brumaire), he was reinstated as a member of the Institute; became a member of the legislative body, of which he was chosen president in 1804; was appointed grand master of the University of Paris in 1808, became a senator in 1810 and was raised to the peerage. During the Hundred Days he was passive, and on the second restoration he was on as good terms with the Bourbon Government as he had been with that of Napoleon. He was nominated a member of the privy council in 1815, and two years later received from the king the title of marquis. D. at Paris, Mar. 17, 1821.
F. M. COLBY.

Fon'te Avella'na, Order of: a monastic order established in 1001 at Fonte Avellana, near Faenza, Italy, by Ludolf, Bishop of Iguvium. In 1570 it was united to the Camaldulians. St. Peter Damian was its most famous member.

Fontenay-le-Comte, fōn'te-nā'le-kōnt': town of France; department of Vendée; on the Vendée (see map of France, ref. 6–D). It has great linen manufactures and tanneries. On May 16, 1793, it was the scene of the victory of the republican army under Chabot over the Vendeans. Pop. (1896) 10,096.

Fontenelle, fon'te-nel', BERNARD LE BOVIER, de: author; a nephew of Corneille; b. at Rouen, France, Feb. 11, 1657; admitted to the French Academy in 1691, and to the Academy of Sciences in 1697, of which he was perpetual secretary from 1699 to 1741. His *Dialogues of the Dead* was published in 1683, *Discourse on the Plurality of Worlds* in 1686, and *Essay on the Geometry of the Infinite* in 1727. Wrote also *History of Oracles*, and in forty years composed eulogies on about seventy members of the French Academy of Sciences. D. at Paris, Jan. 9, 1757.

Fontenoy, fōn'te-nwaă'; village of Belgium; province of Hainaut; 5 miles S. E. of Tournay (see map of Holland and Belgium, ref. 11–B). Here was fought, May 11, 1745, the famous battle between the French under Marshal Saxe and the allied English, Dutch, and Austrians under the Duke of Cumberland, in which the French won a great victory. Pop. 800.

Fontevrault, fōn'te-vrō': town of France; department of Maine-et-Loire; 10 miles S. E. of Saumur (see map of France, ref. 5–D). In its church are the tombs of Henry II. and Richard I. of England. The church, now a prison, is nearly all that remains of the ancient abbey of Fontevrault, once the mother-house of the monastic order of Fontevrault, founded 1100, and broken up at the Revolution. Pop. (1896) 2,853.

Fonvielle, fōn'vi-el', WILFRID, de: aëronaut and popular scientific writer; b. in Paris, France, in 1828; was a teacher of mathematics, then a journalist, and finally aëronaut. During the siege of Paris he escaped from the city in a balloon. Among his works are *L'homme fossile* (1865); *Les merveilles du monde invisible* (1866); *Éclairs et tonnerres* (1867; translated into English by T. L. Phipson under the title of *Thunder and Lightning*); *L'Astronomie moderne* (1868); *La conquête du pôle nord* (1877); *Les saltimbanques de la science* (1884). Accounts of his balloon ascensions were published in 1871, and translated into English under the title of *Travels in the Air*. He has written several political and polemical pamphlets; thus in 1879 he published *Comment se font les miracles en dehors de l'Église*, in which he reviews the claims of spiritualist mediums from a common-sense standpoint.

Food [M. Eng. *fode* < O. Eng. *fōda* < Teuton. *fōd-* < Indo-Europ. *pă(t)-*; cf. Lat. *pasco*, feed, *pā'bulum*, food, Gr. πατεῖσθαι, to eat]: a substance which supports the functions and powers of the body—one by which the body may live, act, and grow; aliment. It is not one which simply satisfies or arrests appetite, for a nauseous smell or a mental shock will do that; nor one simply which gives a sense of satisfaction at the stomach and removes craving for food, like the lump of clay which is swallowed by savages in the absence of food; yet food does both. Neither is it a substance which controls and regulates the functions, for that is the special duty of a medicine; and yet it so far governs that it increases the activity of some or all of them. With want of food there is a natural subsidence of vital action, accompanied by craving for food and appetite or relish for it, while after food has been eaten the action of the heart, lungs, and other organs is increased, heat is generated more freely, appetite is arrested, and a sense of satisfaction is felt. After an interval of three or four hours appetite and a sense of want of food return, and the process of renewal must be repeated.

Food must be identical with the elements of our bodies, or be capable of transformation into them, supplying the want caused by waste and the material required for growth. It must also be adapted to the needs of the infant as well as those of man at all ages and in various conditions of season, climate, modes of life, and exertion. Its nature must be such that it can be digested within a proper period, lest the body starve while food is within it; but this is commonly assisted by the process of cooking, which by softening the food shortens the term subsequently required for digestion. Thus a piece of the bark of a tree may contain the elements of food, but in a form most difficult of digestion. When in periods of great privation bark has been eaten it has been first broken up into the smallest pieces, immersed and then boiled in water to soften the fiber and to cause the starch-cells to burst. Or again, in infants the digestive powers are feeble, so that they require foodstuffs of the most digestible nature, such as milk, pap, corn-starch, bread, etc. Idiosyncrasy is another factor; articles of food which are easily digested by most people are digested with difficulty by others.

Classification.—As foods have two chief duties to perform—to maintain the heat of the body and supply material for growth and repair—they were formerly classed as *heat-generators* and *flesh-formers.* Included among the former were the starches, sugars, oils, etc., and among the latter the albuminous substances, such as meat, fish, the white of egg, etc. These classes were also called respectively *non-nitrogenous* and *nitrogenous*—the former not containing nitrogen in their molecules. The advance of knowledge teaches that the non-nitrogenous substances also serve for repair and growth of the body, consequently the division into heat-generators and flesh-formers is not logical.

Foodstuffs are usually divided primarily into the inorganic and organic, the former including the various mineral substances—water, oxygen, etc.—found so commonly diffused throughout nature; the latter those which are derived directly from plant or animal life. Organic substances are subdivided into the non-nitrogenous and nitrogenous as above.

Foods will be considered in this article under the two general heads of solids and fluids, the former being divided into three classes, according to their source—viz., mineral, vegetable, and animal.

I. Solid Foods.

A. *Mineral Food.*—The bones, nearly every soft tissue, and the blood require mineral matters combined with acids, and foods supply them in about the following proportion: Common salt, or chloride of sodium, is found in water and in many animal and vegetable substances, and it is usual to eat from one-quarter to one-half an ounce daily with food. Potash is supplied by lemons, oranges, grapes, pineapples, strawberries, mulberries, tamarinds, apples, and nearly all fruits, as well as by potatoes, cauliflowers, cabbages, cucumbers, artichokes, asparagus, rhubarb, and nearly all garden vegetables. Sulphur is contained in albumen (as the white of eggs), fibrin, and casein in proportions of 3½ to 7 parts in 1,000. Iron enters into the composition of most vegetable foods, as potatoes, carrots, cucumbers, peas, cabbages, and mustard, and into many animal substances, as milk and flesh. Aluminium exists in carrots, and silica, or flint, in potatoes, wheat, rice, and numerous vegetable structures. Phosphorus, when combined with a base, as lime, magnesia, soda, potash, etc., is found in nearly all vegetable and animal foods. Thus there are in blood 0·14; barley, rice, and oats, 0·22 to 1·32; milk, 0·56; wheat, 0·8 to 2·0; potatoes, 2·5; casein, 13·2; and in bones, 27 to 72 per cent. It is also found in fibrin, albumin, the brain, and numerous other structures of the bodies of animals.

From this statement it follows that while the need of the body for mineral matter may be supplied in very different quantities, a mixture of foods is the most fitting. But of all classes those which contain fresh vegetable juices appear to be the most important, for without them the nutrition of the body can not be long maintained.

B. *Vegetable Foods.*—The lowest classes of vegetables which supply man with food are the lichens, fungi, mosses, and seaweeds. Lichens and mosses are ordinary articles of food in the northern regions, as in Lapland and Greenland, and supply food to man and beast for several months in the year. Iceland moss (*Cetraria islandica*) has long been appreciated in more southern climates for its mucilaginous quality, and is eaten alone, as an infusion in hot water, or made into various compounds, as Iceland moss cocoa or as a preparation similar to corn-starch. It is deficient in flavor, and requires the addition of sugar and a condiment, but it produces a more valuable infusion than linseed tea. Reindeer moss (*Cladonia rangeferina*) has similar qualities, but is inferior as a nutriment, since while the former yields about 30 per cent. and the latter has only about 1 per cent. of starch, the potato usually contains about 18·0 or 19·0 per cent. of starch. It is inferior in that respect to Iceland moss. Irish or carrageen moss (*Chondrus crispus*), a seaweed, is not equal in nutritive value to Iceland moss, but is a well-known article of food or physic. Seaweeds have long been in use as food in Scotland and the more northern islands of Europe, particularly when other vegetable food is scarce. They have also been used in periods of abundance by a few persons, so that laver (*Porphyra laciniata* and *vulgaris*) is eaten with roast meat at the most luxurious tables. There are many edible seaweeds, but as all have a bitter flavor, which soda only partially removes, they are not likely to be generally used as food. They, however, rank very high in nutritive value, for they are said to contain 10 to 15 per cent. of nitrogenous and 60 to 70 per cent. of carbonaceous matter, and therefore merit the attention of countries having a wide seaboard and a poor population.

Mushrooms (*Fungi*) constitute a large class of vegetables, many of which have most attractive colors, and not a few very repellent odors. Some varieties are edible; others are poisonous. The chief variety used is the common edible mushroom of small size (*Agaricus campestris*). In chemical composition this class of vegetables ranks somewhat high, but they are very light in structure, and from the bulk required at a meal could not become a necessary article of food. They are generally luxuries, or when made into ketchup may be called condiments. Truffles, whether white or black (*Rhizophagon album* and *Tuber cibarium*), grow about a foot in depth under ground, to the size of a potato, and are more fashionable than useful as a food.

Succulent Vegetables.—This very large class of foods is eaten chiefly for their juices and starch, and are prized according to the abundance of these elements and their flavor.

The potato (*Solanum tuberosum*) occupies the first place in temperate climates, on account of the large quantity of starch which it contains, and its agreeable flavor. It is a native of North and South America, but has become acclimatized in all except very hot and very cold climates. It contains only about 2·1 per cent. of nitrogenous matters and salts, and is therefore not fitted to be a sole article of food. The greater the specific gravity the larger is the quantity of starch which it contains; so that with a specific gravity of 1·123 there is 24·14 per cent. of starch, while with a specific gravity of 1·090 the starch is only two-thirds of that quantity, or 16·38 per cent. The sweet potato (*Batatas edulis*) and the yucca are eaten largely in America. The yam (*Dioscorea alata, batatas*, or *sativa*) is a common food in China and many other countries, and contains a quantity of starch scarcely less than that of the common potato, but is not equal to the latter in flavor. There are many edible tubers bearing starch growing in South America, and also a few in North America, as the prairie turnip (*Apios tuberosa*), which contains a larger proportion of edible matter than the common potato. The artichoke (*Cynara scolymus*) is valued for its flavor, as well as for its nutritive qualities. The *Helianthus tuberosus*, or Jerusalem artichoke, has edible and quite nutritious tubers, which are, however, rarely used as human food.

The fruit of the breadfruit-tree (*Artocarpus incisa*) and of the plantain (*Musa paradisiaca*) may be regarded either as culinary vegetables or fruits, but from the quantity of nutritive material which they afford they belong rather to the former. The breadfruit is always cooked by baking in an earthen oven or on heated stones, and then resembles wheaten bread.

The carrot (*Daucus carota*), parsnip (*Pastinaca*), beet (*Beta vulgaris*), turnip (*Brassica*), vegetable marrow, and pumpkin (*Cucurbita*) occupy a position between potatoes and ordinary green vegetables, since they contain a larger quantity of starch and sugar, and are therefore more nutritious, than the latter. They are nearly equal in nitrogenous elements—viz., about 1·3 per cent.—but in reference to sugar they vary as follows: turnips, 2·1 per cent.; parsnips, 5·8; carrots, 6·1; and beets, 10·5. Swedish turnips contain more carbonaceous matter (starch and sugar) than the white variety, but the flavor is harsher, though in the U. S. the more delicate varieties are highly prized.

All the well-known succulent vegetables, as spinach, turnip-tops, cabbage (*Brassica*), broccoli, cauliflower, sea-kale, tomatoes, nettles, lettuce, dandelion, endive, chicory, may be regarded as nearly alike in nutritive value, while they vary extremely in flavor, and are chiefly valuable for their fresh juices. They should be well cooked, for if eaten in large quantity they do not readily digest. No part of a dietary is more valuable than the abundant supply of such substances, but when eaten raw or in salad it should be in moderation. Cucumbers (*Cucumis*) are regarded apart from this class, since they are always eaten raw, but are difficult of digestion, and have very little nutritive value. Rhubarb (*Rheum*) has the character of a fruit rather than a vegetable, and has juices that are very valuable. Wild lettuce (*Lactuca sativa*) is poisonous, while when cultivated it is both harmless and agreeable.

Fruits may now be considered, since they are more like succulent vegetables than any other productions in the composition of their juices and their uses in the animal economy. It is needless to cite them by name, as they are well and widely known, and it would be impossible to refer to more than a very small proportion of them. No products are so universal and none so agreeable. All agree in having a larger proportion of sugar and vegetable acids and salts than occurs in ordinary vegetables, and flavors of infinite variety and delicacy. Some, as the date, are so valuable as to be a chief support of life, but the characteristic of the class is to afford agreeable and refreshing rather than nutritious elements. It is, however, worthy of note that in these qualities the choice fruits of the gardens and hothouses of Europe and the U. S. far excel those of the products of Eastern climates, while the chemist has produced substances which closely imitate the flavor of all the most appreciated fruits. The following table contains the percentage, quantities of water, sugar, and free acid in ordinary fruits:

FRUITS.	Water.	Sugar.	Free acid.
Grapes, generally	79·8	13·8	....
Klaubegen, ripe	....	10·59	....
White Austrian	....	13·78	....
Red Asmannshäuser, ripe	....	17·28	....
Oppenheim, ripe	....	13·52	....
" overripe	....	15·14	....
Johannisberg	....	19·24	....
Mulberries	84·7	9·19	1·86
Bilberries	77·5	5·78	1·34
Blackberries	86·4	4·44	1·18
Cherries, black	79·7	10·70	0·56
" sweet, light red	75·3	13·11	0·35
Apples, English golden pippin	81·8	10·36	0·48
" English russets	82·0	6·83	0·85
Pears, sweet red	85·0	7·94	trace.
Strawberries, wild	87·0	4·55	1·33
" cultivated	87·4	7·57	1·13
Raspberries, wild	83·8	3·59	1·98
" cultivated, red	86·5	4·70	1·35
Plums, green gages, yellow	80·8	2·96	0·96
" " large and sweet	79·7	3·40	0·87
Apricots, large	82·1	1·50	0·76
" small	83·5	2·73	1·60
Peaches, Dutch	84·9	1·58	0·61
Gooseberries, large red	85·5	8·06	1·35
" small	84·8	8·23	1·58
Currants, white	83·4	7·12	2·53
" red	85·2	6·44	1·84

Seeds.—The seeds of plants have so much in common that they may be treated under one head, notwithstanding their infinite variety of flavor and diversity of production. The most highly nitrogenized seeds are peas, beans, lentils, and numerous other products of pod-bearing plants, called pulses, or dahls and grain in India, and frijoles in Mexico. White potatoes contain about 2 per cent. of nitrogenous matter, peas have 23 and lentils 25 per cent., and are the most highly nitrogenized natural foods known to mankind. They are also rich in starch, for peas contain 55 per cent. of that substance. Whole nations are largely indebted to these foods for their highest nourishment, and it seems as if the nitrogenous vegetable food were more suitable to the body in hot climates than meat. The 4 oz. of dahls which each inhabitant of a large part of India eats daily is to the rice accompanying it that which buttermilk is to the potato in Ireland; and it is scarcely possible to overestimate its value. The flavor is, however, somewhat harsh as compared with that of fine wheaten flour, and with the luxurious habits of the age the latter, although affording less nutriment, is preferred. The most agreeable member of this class in Europe is the haricot bean, which is in almost daily use in France, and is served alone or with meat and sauce. All such foods require to be well cooked by boiling, and the skins should be rejected. They are deficient in fat, and consequently demand an addition of that food. When eaten too abundantly and constantly they are liable to produce skin-disease and indigestion. The least nutritious seed in nitrogenous matters in extensive use is rice, for it contains but 6·3 per cent., and the next is millet, with 9 per cent.; yet these substances supply the chief food of more than half of the inhabitants of the world. At the same time they supply a proportionally greater amount of starch—viz., rice 79·1, and millet 74 per cent., as against 55·4 per cent. in peas. Experience has shown that whatever may be the use of nitrogen, it is most abundant in food used in cold climates, while starch is the reverse. As a part of the dietary they are agreeable and valuable. Ground rice can not alone be made into a loaf, but small cakes and biscuits are prepared with it. Parched rice made into *sulpawn* is in common use in the East.

The seeds which supply staple vegetable foods occupy a position between these and peas, and have a close similarity in their nutritive qualities—viz., wheat, maize, and oats, which possess 11 to 12 per cent. of nitrogenous and 75 to 80 per cent. of carbonaceous matter. They differ in flavor, so that both maize and oats are said to be rough, while wheat has a softer and perhaps sweeter flavor, and although wheat has the preference wherever it is grown, each kind of corn has its advocates. Regarded simply as nutritive foods, one may be substituted for the other.

Bread which is made from wheat may have all or any part of the husk or bran of the grain in it. If there be much it is called brown-bread, and as the flinty covering of the bran is indigestible, it is very apt to cause purging, and is the rich rather than the poor man's food. White flour has lost some of the nitrogen of the bran, but it is more digestible and therefore more useful, and probably the most nutritious kind is that known as seconds or households. Fourteen pounds of fine white flour should make 19½ to 20 lb. of bread. Passover cakes are made from the finest and purest flour. Oatmeal is rarely obtained entirely devoid of the hard and indigestible skin, to which also it owes its high percentage of nitrogen; but when the whole grain has been decorticated it is known as groats. Maize is the only grain under consideration which is eaten whole in its unripe condition and when full of milky juices, but whole ripe wheat is steeped in water to make frumenty, and both the oat grain and the skin of the oatmeal are used to make foods in Wales and Scotland under the name of *sowens* and *sacan* or *slymru*. Very valuable preparations for infants' food and puddings are made from them, as corn flour, hominy, and semolina.

The nutritive qualities of all these grains vary with climate and season, so that moderately hot and dry climates and seasons produce the best wheat, and the highlands better oats than the lowlands. The *tortilla* is a cake prepared in Mexico and South America with ground maize, while johnny-cake and corn bread are commonly made in the U. S. from the same grain.

Rye and barley, although inferior grains, are largely eaten by the poorer inhabitants of Northern and Central Europe. The proportion of nitrogenous matter is only from 7 to 8 per cent., and therefore but little exceeding that of rice and millet, while the carbonaceous is 78 to 80 per cent. An improved food is made by a mixture of rye and wheat called *maslin*, which is in use in Northumberland and North Yorkshire, and it is not unusual to add a little rye meal to wheat meal in making bran bread, with a view not to increasing the nutritive value of the latter, but to keep the bread moist. The Norwegian *flödegröd*, or cream porridge, is made by boiling barley meal in cream, during which process it is stirred with a *grödstick* twisted between the palms of the hands.

The following table shows the percentage composition of the chief representatives of this class of seeds and foods:

SEEDS, ETC.	Water.	Nitrogenous.	NON-NITROGENOUS, INCLUDING			Salts.
			Sugar.	Starch.	Fat.	
Maize	14	11·0	0·4	64·7	8·1	1·7
Millet	13	9·0	74		2·6	2·3
Rice	13	6·3	0·4	79·1	0·7	0·5
Oat meal	15	12·6	5·4	58·4	5·6	3·0
Wheaten flour, seconds	15	10·8	4·2	66·3	2·0	1·7
Wheat bread	37	8·1	3·6	47·4	1·6	2·3
Barley meal	15	6·3	4·9	69·4	2·4	2·0
Rye meal	15	8·0	3·7	69·5	2·0	1·8

Nuts.—There are numerous seeds which are regarded as fruits from their agreeable flavor and unfitness to be eaten as standard articles of food, such as the cocoanut (*Cocos nucifera*), Brazilian nut (*Bertholletia excelsa*), ground-nut (*Arachis hypogœa*), walnut (*Juglans*), chestnut (*Castanea*), and almonds (*Amygdalus communis* and *amara*), constituting a very large class, and found in almost every part of the world except the extreme north and south. They are rich in albuminous, saccharine, and fatty elements, and supply a much larger quantity of nutriment than the ordinary cereals. The cocoanut is doubtless the most valuable nut in hot countries, both as yielding fluid and solid food, besides oil and fat for commercial purposes; while the edible chestnut is the most useful in temperate climates, and supplies a larger proportion of starch and smaller proportion of fat than the cocoanut. The nutritive value of these products has not yet been sufficiently appreciated, but as a rule they are very indigestible.

Starchy Foods.—Foods which are composed almost exclusively of starch are artificial, for they must be prepared by man from natural foods. Such are sago, tapioca, arrowroot, cassava meal, and manioc. None are absolutely destitute of nitrogen, but the quantity is so small that it may be practically discarded in calculations. Sago is obtained from several palms by beating and washing the pith, while all the others are extracted from roots or tubers. Arrowroot is prepared from the *Maranta arundinacea*, or even the potato, and the others from the *Jatropha* and other euphorbiaceous plants, which contain poisonous juices until expelled by heat. The process is the same in all—viz., to beat the root and wash and dry the fecula. The size and color of the grains depend upon the mode of preparation. All are practically equal in nutritive value, but Bermuda arrowroot is generally preferred in the market. These foods may be readily distinguished from each other by the microscope, which shows the figure and size of the starch-cells. As all are really starches, their respective values depend upon flavor and cheapness, and not upon their relative usefulness in the system. All alike require to be sufficiently cooked, so as to burst the cells and to thicken the fluid in which they are macerated, and for the use of young infants must be given with milk and other nitrogenous food.

Sugar is found in almost every kind of vegetable foods, but particularly in fruits, where it is called fruit or grape sugar; in the sugar-cane (*Saccharum officinarum*) and Chinese sugar-grass (*Sorghum saccharatum*), where it is known as cane-sugar; and in milk, as milk-sugar. The composition of sugars varies only in the elements of water, and that of cane is $C_{12}H_{22}O_{11}$; but all are not equal in sweetening properties. The quantities per cent. found in certain foods are as follows: Raw sugar, 95; treacle, 77; buttermilk, 6·4; carrots, 6·1; parsnips, 5·8; oat meal, 5·4; skim milk, 5·4; new milk, 5·2; barley meal, 4·9; wheat flour, 4·2; rye meal, 3·7; wheaten bread, 3·6; potatoes, 3·2; turnips, 3·1; peas, 2·0; Indian meal and rice, 0·4. See SUGAR.

Honey is not the product of the bee, as many believe, but is simply collected by that useful insect from flowers, and has a flavor varying with its source. In Turkey and other countries that procured from certain plants is poisonous, and other kinds are very unwholesome.

Manna as ordinarily obtained is derived from the juices of the manna ash, growing in Southern Europe. It is also found as a deposit upon the trees and ground under certain conditions of weather and climate, when it is in grains as small as a coriander-seed, and if not carefully picked will be mixed with other substances. Its peculiar substance is called *mannite*.

C. *Animal Foods.*—All kinds of flesh have their essential properties in common, and for ordinary dietetic purposes are interchangeable; but as lean corresponds with lean and fat with fat, the true distinction is the proportion of one to the other: thus there is the largest proportion of fat in the pig, and a greater proportion in sheep than oxen as ordinarily fed and when ready for the butcher. The same quantity of food produces a larger quantity of fat in one than in the other: thus with 100 lb. of nitrogenous food the pig produces 13·5 lb. of fat, the sheep 4·2 lb., and oxen 4·1 lb., while the same quantity of carbonaceous material produces 18·5 lb., 9·4 lb., and 7·2 lb. in the three classes.

The flesh of all animals consists of bundles of extremely fine tubes which contain the muscular substance. The better the breed and feeding the richer are the flavor and fat, while the older the animal the tougher are the fibers or tubes and the tissue which connects them. Each class of animals has its own special characters, but the quantity of meat depends upon these two conditions. This is true of the nitrogenous part of an animal, but the fat, which is carbonaceous, is nitrogenous only to the extent of the fine nitrogenous tissue in which it is contained. Beef has always been regarded as the kind of flesh which gives the best nutriment to the eater, while mutton and poultry are softer in texture and more delicate in flavor. The flesh of wild animals approaches to, if it does not excel, beef in nutritious qualities, but it is almost always harder, and requires more cooking to separate its fibers. The rich flavor of wild game is nearly lost with domestication. Pork and veal have always justly been regarded as less digestible than beef.

The juices of flesh are obtained when making beef-tea. The meat is cut into small portions which are placed in a bottle, and the bottle allowed to stand in warm water, the juice being drawn off from time to time as it collects. It contains considerable of the salts which were present in the flesh and some albuminous matter. Liebig's and similar extracts of meat are valuable as nervine stimulants and meat flavorers, but are not a rich nutrient in the ordinary sense of the word, and should not be depended upon to serve as foods without admixture of other nutritious substances.

The flesh of fish contains more phosphorus, and differs little from that of animals in chemical composition, but much in texture and flavor, and the nearest approach is found in salmon and sturgeon. The proportion of fat and oil to flesh is in some kinds greater than that of quadrupeds, for the eel contains 50 per cent., herring 30 per cent., and a salmon in fine condition 10 to 20 per cent. Whitefish usually contains less than red-blooded fish, but some of the former, as the cod, lay up a large store of oil in the liver. Fish is rich in phosphorus. On the whole, fish is excellent food, but not equal to flesh, nor sufficient to maintain full health and strength. Leprosy is found chiefly in fish-eating and poverty-stricken populations. The roe of fish is a luxury, and contains both albuminous and fatty matters, and when obtained from the sturgeon and some other fish, and prepared, is called *caviare*. It is eaten raw in Sweden and Russia as an appetizer before dinner. The gelatinous parts of fish, as the head and fins, are also much prized, but unless eaten in great quantity do not suffice for a meal. When fish, as herring, is cheap, it is the cheapest of all animal foods in the market in proportion to the nutriment contained in it, but its price is subject to great variation. Oysters are readily digested and are of great nutritive value, while lobsters and similar shellfish are too indigestible to be eaten by some persons with impunity.

Eggs consist chiefly of albumen, but the yolk contains oil, and there are also sulphur and other elements which have a certain nutritive value. They are not fitted to supplant flesh, but rank next to fish. All have the same nutritive value in proportion to their size, but some are repelling in flavor, as those of fish-eating birds, while others are delicious, as those of well-bred and well-fed barnyard fowls. Those of the plover are among the most delicate in flavor. It is not desirable that they should be boiled hard, unless to be grated down, but they may be boiled, as in puddings, when well divided into the semi-liquid state. The highly nutritious quality of an egg may be appreciated from the following percentage analysis, and but few know that it contains so large a proportion of fat as is shown in the following statement: thus dry matter, 30; dry fat, 11·0; carbon, 17·52, or carbon and nitrogen reckoned as carbon, 20·56; mineral matter, 1·4; nitrogen, 2·0; besides water.

Gelatin is a valuable food, notwithstanding the erroneous inferences which have long been drawn from the report of the French gelatin commission, and in composition is nearly identical with albumen. Isinglass is the best form of it, but in China certain birds' nests, with which soup is made, have the preference. It is, however, usually obtained from the bones, skins, and hoofs of animals.

Casein is obtained principally from milk, but exists largely in pease and almonds, and has the same nutritive character as albumen and gelatin. As ordinarily found in cheese, it is mixed with a proportion of fat (butter), and by drying, as well as by decomposition, acquires a flavor very different from that of fresh curd. While the latter may be eaten with impunity, the former is digested with difficulty and requires careful mastication. Skim-milk cheese contains a larger proportion of nitrogenous and a less proportion of carbonaceous matter, as shown in the following percentage analysis:

DESCRIPTION.	Water.	Nitrogenous.	Fat.	Salts.
New-milk cheese, very good.	36	28·4	51·1	4·5
Skim-milk cheese........	44	44·8	6·3	4·9

The proportion of fat varies much in the best kinds of cheese, as from 18·7 in Neuchâtel to 32·3 in Roquefort, while in an ordinary Cheshire cheese it is 26 per cent. The chemical composition of all these elementary substances, and also of flesh if perfectly freed from fat, is almost identical, and may be illustrated by that of albumen, which is C., 53·4; H., 7·0; O., 22·1; and N., 15·7. Hence the nitrogenous element is somewhat more than one-sixth, and the carbonaceous more than one-half of the dried substance.

Offal.—The offal of animals is the head, feet, liver, lungs, and heart, while the blood and bowels may be added to the list for dietetic purposes. The heart consists of muscular fiber or flesh, having, however, a firmer texture, is not so easily masticated, and is much inferior to other flesh as food. The lungs and liver consist largely of albuminous, and the head and feet of gelatinous matter, and while not equal to flesh are very good foods, and might be eaten by the poor more largely than at present with advantage. Tripe is prepared chiefly from the stomach of the ox, and contains much fat as well as albuminous and gelatinous substances. Its flavor is delicate, and it is quickly digested. Blood is less valuable as a food than any of the foregoing, but as it contains all the elements under discussion, besides iron and other valuable mineral matters, it should be eaten. When heated to 212° F. it loses any diseased taint that it might have acquired. The nutritive elements in liver and tripe may be ascertained from the following percentage analysis, and compared with a similar one on vegetable foods already given:

SUBSTANCE.	Water.	Nitrogenous.	Fat.	Salts.
Ox liver....................	74	18·9	4·1	3·0
Tripe......................	68	13·2	16·4	2·4

The time required for the digestion of these animal substances was investigated by Dr. Beaumont, with the following results: pigs' feet and tripe, 1 hour; whipped eggs, salmon trout, and venison steak, 1½ hours; ox liver and dried codfish, 2 hours; roasted eggs, 2¼ hours; turkey, gelatin, goose, sucking pig, and lamb, 2½ hours; fricasseed chicken and boiled beef, 2¾ hours; roasted beef and boiled mutton, 3 hours; roasted mutton, 3¼ hours; stewed oysters, cheese, hard-boiled or fried eggs, 3½ hours; fried beef, boiled and roasted fowls, roasted ducks, 4 hours; and pork, 5¼ hours. Similar investigations have since been conducted by Smith, Richet, and others.

Fats.—The richest hydrocarbonaceous food is fat. The relative composition of fat, starch, and sugar, is shown in the following table:

SUBSTANCE.	Carbon.	Hydrogen.	Oxygen.
Fat........................	77	12	11
Starch.....................	44	6	50
Sugar......................	42	6·5	51·5

It is customary to reckon fat as equal to one and three-fourths times its weight of starch. All fats have nearly the same composition when freed from water and the tissues in which they are contained, so that one may be substituted for another; but they differ in flavor and the temperature at which they liquefy. So also oils remaining liquid at ordinary temperatures may be eaten instead of solid fats. The fats of meat, butter, lard, and dripping are the fats in most general use, and in their natural state the last contains the greatest proportion of the hydrocarbons, since it has the least proportion of water. The fat of meat is selected simply for its flavor, but butter varies with its manufacture, since it may contain ½ oz. to 3 oz. of water, and ½ oz. to 2 oz. of salt in the pound. Its flavor is due largely to the food of the animal—as, for example, turnips—and the nature of the animal, for it has a much stronger flavor when produced from the goat or the buffalo than from the cow. A clarified butter called *ghee* is used in India, but is by no means as agreeable as our butter. It is prepared from milk (not cream) by first adding *dhye*, or sour milk, and afterward hot water, and by churning. In a few days it becomes rancid, and is again clarified, and then kept for use in closed pots. Fat of every kind becomes rancid, unless subjected to some preserving process. Thus fine sugar is used in condensed milk, salt is added to butter and lard or rubbed into pork or other meat fat. The quantity which is consumed by an adult daily is probably 2 to 4 oz. in temperate regions, but in cold climates as many pounds may be eaten.

There are no animal oils which are avowedly used as food in temperate climates, but in the far north whale oil or seal oil is taken either with or without the solid mass which constitutes the blubber. Lard oils and other animal oils are used largely to adulterate vegetable oils, and fish oils are used as medicines. Vegetable oils are, however, in great request in all temperate and hot climates, and are derived from the seeds of many plants, and particularly from the pulpy pericarp of the olive, and are a much more agreeable and convenient food than butter. The finest salad oil, expressed from the olive berry without heat, and the oil of cucumbers are deliciously mild in flavor, and good food. No separated vegetable fat is ordinarily used as food in temperate climates, but both fat and oil are eaten largely in certain seeds, as the Brazilian nut (*Bertholletia excelsa*), the cocoanut (*Cocos nucifera*), and almonds (*Amygdalus*). Fats and oils derived from various seeds are much more commonly used in India and other hot countries than in Europe and America.

Condiments.—Condiments are rather adjuncts to food or appetizers than food, although vegetable substances used therein are nutritious. This term includes pickles and sauces, which are almost innumerable, besides pepper, mustard, and vinegar, alone or in combination with other substances. The luxurious habits of the day lead to a free use of these substances, but he who would retain a natural taste for food and a good digestion should either eschew them or use them in their milder forms and in great moderation.

II. Fluid Foods.

Milk is the type of nutritious fluids, since it contains all the elements of nitrogenous and carbonaceous foods in a fluid form. It is therefore adapted to every condition of man, but particularly to such as require the immediate use of food, as in infancy and when there is not time for prolonged digestion. It contains casein and albumen as its chief nitrogenous elements, and sugar and fat as its carbonaceous, besides salts of the most valuable kinds. The proportion of each varies in different animals and with age, food, and climate, while certain special flavors, due to peculiar fatty acids, mark each kind. With so much variety it is impossible to give more than a general analysis, but even that has at least a comparative value, as in the following table:

MILKS.	Sp. gr. +1,000.	Water.	Solids.	Nitrogenous compounds.	Sugar.	Fat.	Salts.
Goat......	33·53	84·49	15·61	3·51	3·69	5·68	0·61
Sheep....	40·98	83·23	16·77	6·97	3·94	5·13	0·71
Mare.....	33·74	90·43	9·57	3·33	3·27	2·43	0·52
Ass.......	34·57	89·0	10·99	3·56	5·05	1·85	0·54
Woman...	32·67	88·9	10·92	3·92	4·36	2·66	0·13
Cow......	33·28	86·4	13·59	5·52	3·8	3·61	0·66

The salts in milk are small in quantity, but of the utmost value in nutrition, and consist of the following in 100 parts: potash, 23·46; soda, 6·96; lime, 17·34; magnesia, 2·20; chloride of potassium, 14·18; chloride of sodium, 4·74; phosphoric acid, 28·40.

Human milk is the standard of comparison for the food of infants, and varies in quality with health, food, production, and anxiety, but a mixture of two-thirds of ordinary cow's milk with one-third of water and half an ounce of milk-sugar or cane-sugar in a pint is a tolerable approximation. Ass's milk is sometimes substituted, and equal parts of it and cow's milk fairly represent human milk. For adults the milk of the cow, goat, and sheep is preferable. Skimmed milk has lost nearly all its fat or butter, but is used to a large extent as a food in certain chronic diseases. The addition of half an ounce of suet in a pint makes it equal to new milk. Buttermilk differs little from skimmed milk, except that it has become sour by the transformation of sugar into acid, and it is in constant use as a food in Ireland, Wales, and many other countries. Whey is much less valuable, since it has lost both the fat and the casein, but it offers an agreeable drink in warm weather, and the useful salts of milk. It is, however, never absolutely destitute of fat and casein, and has some nutritive value from its milk-sugar. Preserved milk may be made from either new or skimmed milk, or with a part only of the cream removed. It may be simply condensed, so that four parts become one, in which state it will remain good from one to four weeks, or it may be preserved so as to remain undecomposed for many months by the addition of refined sugar and an alkali, and by evaporation. A one-pound tin contains 3 to 4 oz. of sugar, and as sugar is destitute of nitrogen, the proportion of nitrogen in the milk is thus reduced. The proportion of nitrogen to carbon in natural milk is about 1 to 12, which is little more than in bread, while in sugar-preserved milk it is about 1 to 20.

Tea, Coffee, Cocoa, Chocolate.—These substances, from which so many beverages are made, have elements in common by which a sort of unity is given to the whole—viz., the chemically identical compounds called *theine* in tea and *caffeine* in coffee; while the *theobromine* of cacao and chocolate, though by no means of the same composition, is believed to have analogous effects upon the animal economy. The quantity is too small to be regarded simply as a nutrient, but it is believed to exert a peculiar action on the nervous system. See TEA.

Tea should always be prepared with water which has just begun to boil, and before the air is expelled, and the water should be soft, or be softened by the addition of a pinch of carbonate of soda. It has a powerful action on the respiratory system by which that function is greatly increased, and also over the nervous system, by both of which wakefulness is very commonly produced. It should be taken with the meal, rather than alone or when fasting. It is especially fitted for warm weather, when there is a desire to cool the body, for it produces perspiration. Europeans and the people of the U. S. drink a much stronger infusion than the Chinese, but do not do so with impunity, for it is apt to produce nervous and mental excitement and indigestion, and is not unfrequently followed by a reaction in which the spirits and vital powers are depressed.

In preparing coffee for the table it should be freshly ground and placed in cold water, which should be brought to the boiling-point and then served. Hot new milk or cream may be added to it. Its actions are like those of tea, but it is more apt to cause wakefulness.

Chicory has an analogous action to coffee, but in greatly inferior degree. It is prepared from the root of the well-known vegetable after it has been roasted with fat, dried to a brown color, and ground into powder. See COFFEE.

Chocolate and cocoa are produced from the seed of the *Cacao theobroma*, the pods of the ground-nut *Arachis hypogæa*, the cacao-shrub of Zanzibar, and other plants. The nuts are coarsely broken and called cacao-nuts, after which they are carefully ground under a considerable pressure and with wheels having a very smooth surface, so as to be reduced to an impalpable powder. Sugar is usually added in preparing chocolate, but not so generally to produce cocoa. The peculiar principle which they possess is called *theobromine*, but the flavor depends upon volatile oils and fat, which constitute 34 to 37 per cent. of the whole.

Alcohols.—The limits of this article do not allow more than a general sketch of these important substances. Ordinary or ethylic alcohol is the product of the fermentation of saccharine substances, whether they be malt, grain, potato, beet-root, sugar, or molasses, and comes over, mixed with other compounds, in distillation. The portions which distill early in the process are the finest and purest, and are used for the manufacture of the finest essences and spirits, while the latter are mixed with an increasing quantity of fusel oil, until at length they are fit only for the manufacture of varnish. Alcohol is an artificial and not a natural product, and in the process referred to is mixed with a proportion of water, but it is possible by a further process to remove the water, when the remaining fluid is called absolute alcohol (specific gravity 0·793). It is never sold in this form for use as food, but is mixed with water, and when about equal quantities of water and absolute alcohol are added together, *proof spirit* is produced, with a specific gravity of 0·920. When spirits of various kinds are manufactured they are prepared of various strengths, but usually brandy is imported at 1° or 2°; whisky at proof, or 10° over proof; rum at 25° to 35° over proof; and gin at 17° under proof, which means that if a number of gallons of water equal to the degrees over proof were added, the result would be proof spirit. The retailer often lowers the quantity of the spirit by adding water, so that he may sell the same spirit at 10° to 30° under proof.

Many deny that alcohol is a food, asserting that the fluid is not decomposed and transformed, but leaves the body in the same or an analogous condition to that in which it entered, while others dispute the inference, because the alcohol administered in any one experiment has in no case been all recovered in the excretions. But alcohol is only one of the elements in this class of fluids, and does not therefore give a uniform character to them all. The essential oils in brandy and other spirits, which are developed in the manufacture or produced by time, give approved flavors, and rum contains a large quantity of sugar. Alcohol when taken in moderate amounts is almost immediately changed within the system, and the final products of its decomposition are rapidly eliminated, but when ingested in excessive quantities the early derivative products remain in the tissues for a period of one or two days. The addition of juniper berries to hollands and gin stimulates the kidneys, and thus early tends to carry off the alcohol and its derivatives, but if habitually indulged in may go beyond the necessities of the case and bring on kidney disease. Wines produced from the grape only obtain the alcohol which they possess from the fermentation of the sugar in the juice of the grape, and if the fermentation be complete, no sugar remains. Sugar bears a proportion to the other elements of the juice, and as the quantity of alcohol produced is a measure of the sugar, it is also a measure of all the elements, and therefore, as is the alcohol in natural wine, so is the value of the grape-juice. Thus the wines of comparatively cold climates, as the Rhine and north of France, do not yield more than 9 to 16 per cent. of alcohol, while those of hotter climates and volcanic soils, as Greece, yield 26 or 27 per cent. The latter therefore are fuller in body than the former, and so far should be more valuable as food.

The salts in wine are valuable as food, as, for example, the tartrates and malates of potash, which give a tartness (but not from a free acid) to natural wines, and are deposited with age, or more rapidly when gypsum (sulphate of lime) is added, which sets free the vegetable acids. When the wine is red the coloring-matter and tannin are deposited with them and form a crust; but in old white wines the tartar may be seen as a whitish powder, moving as the bottle is turned up. The chief advantage of such wines (apart from alcohol), when comparatively new, lies in these salts, but when older in the essential oils and ethers.

There is a flavor and a bouquet connected with each kind of wine which gives pleasure to the consumer, and introduces it into the class of luxuries. Such as are in general favor command prices far beyond their value as food, and indeed beyond any value besides that of rarity. Their choice qualities are due partly to growth, for one plot of ground may produce flavors far superior to that of an adjoining vineyard; partly to selection of the ripest grapes and care in the manufacture; partly to the process of maturation, which can not be determined beforehand; and partly to the age of the wine, and hence skill and capital are largely required to produce a luxurious if not a dietetic wine. The production of this class of wine is most rapidly extending, and now embraces the central parts of Europe, Italy, Greece, Hungary, large districts in the U. S., Australia, and the Cape of Good Hope; but hilly or mountainous ranges, with a warm soil and sunny skies, without extremes of heat and cold, are the most suitable, and the limits may be indefinitely extended.

Fortified wines (and therefore adulterated) are those to which alcohol is added which was not produced from the grapes under manipulation, and which are commonly of inferior quality. Such are port, sherry, and madeira, which are rather weak ardent spirits or liquors than wines. The strength of these wines is from 38 to 42 per cent. of alcohol, and the objects of the manufacturers are to gratify a taste for strong liquors and to preserve the wine. They are prepared for particular markets, and not for home consumption, so that such port and sherry as are sent to Great Britain are not consumed in the countries of their production. The alcoholic strength of champagnes varies very much, but seldom exceeds 20 per cent.

True champagne and other effervescing wines are prepared from ordinary grapes, but the juice is chosen with great care as to its flavor, bouquet, and sugar, and such a combination is made as will produce the quality of champagne which the manufacturer desires. It is fermented in large vats or in smaller casks, after which it is drawn off, fined, and placed in underground cellars. Here it is frequently racked and fined until the following April, when it is bottled, and for three weeks again ferments freely. It is then kept under watch for two, three, or four years, during which time it is at first turbid, but afterward deposits a substance which by proper inclination of the bottle is left upon the cork; and the latter being skillfully removed, allows the deposit to escape. In this state the wine is matured, and called *vin brut*; and if the quality of the grape was fine and the subsequent treatment successful, the wine is very dry and has the flavor of the grape. Rhine and Moselle wines are prepared in this state for the market with great success, but it is much more common to add a sweet compound of the finest sugar-candy, champagne, and old cognac or other liquors, by which the required sweetness and alcoholic strength are produced. The quantity of this liqueur is usually from 2 to 6 per cent., but it varies with the natural richness of the juice of the grape converted into champagne. The effervescence is creamy rather than frothy, and rises in bubbles for hours rather than discharges the gas at once, and the bouquet and aroma are perfect. The Muscadine, Lemel, and Frontignac grapes have special odors which remain in the champagne, and some of the ripest bunches are allowed to hang in the cask. Red grapes naturally give a slight tinge to the wine, but pink champagne is artificially colored with cochineal. It is said that a bitter principle is added to certain kinds to modify the sweetness. There are certain wines, as Frontignac, Cyprus, and Tokay, produced from grapes which are allowed to dry upon the vine, and thus become raisins. The flavor readily proves this fact, and as the resulting wine is never perfectly fermented, it is rich and luscious, and contains much sugar. From the foregoing observations it will be seen how readily fictitious wines may be made. See PRESERVATION OF FOOD.

Revised by EDWARD T. REICHERT.

Fool, or **Court Jester**: See LICENSED FOOL.

Fools, Festival of (transl. of Lat. *Festum Stultorum*, or *Festum Fatuorum*): a mediæval Christian merry-making of fantastic and childish character, which fell especially upon Holy Innocents' Day (Dec. 28), but had more or less to do with the whole period between Christmas and Epiphany (Jan. 6). Exercises were held in the principal church edifice of the place; a mock pope, archbishop, or bishop was chosen; and all the most sacred rites of Christianity were travestied. The wild license which reigned resembled that of the old Roman *Saturnalia*. The leading performers were of the lower clerical orders, especially the subdeacons; hence another name for the festival, *Festum Hypodiaconorum*, with some reference to St. Stephen, who is commemorated on Dec. 26. The aim professed was to interest young and ignorant people in the story of the Advent, but profaneness soon got the better of piety in the matter. This festival, which is first mentioned by the Parisian ritualist, John Beleth, in the latter half of the twelfth century, originated apparently in France, and was more popular there than anywhere else, though observed also in Spain, in Germany, and in England. In spite of repeated condemnations by prelates and councils, it survived the Protestant Reformation, one instance of its observance being reported as late even as 1644.

Fools' Parsley: a poisonous umbelliferous plant (the *Æthusa cynapium*), so called because its leaves slightly resemble in appearance those of some varieties of parsley, so that people who have by mistake gathered it have been seriously poisoned by it. It is a native of Europe, naturalized in the U. S. It may be distinguished by its acrid taste and fetid smell; its general umbels have no involucre; its minor umbels a partial involucre of three leaves; in both respects quite unlike parsley. It is an acronarcotic, causing numbness, faintness, and dimness of vision. Give as an antidote a thorough emetic, followed by wine or other gentle stimulant.

Foot [M. Eng. *foot*, *fot* < O. Eng. *fōt* : Icel. *fōtr* : Goth. *fōtus* : O. H. Germ. *fuoz* > Mod. Germ. *Fuss* < Teut. *fōt* < Indo-Eur. *pōd*, *pŏd-*, *pĕd* > Gr. πούς, ποδός, foot : Lat. *pes* : *pedis*, foot]: in anatomy, the terminal part of man or an animal.

Foot of Mammals.—The foot (*pes*) in mammals, and in some other vertebrates in distinction from the hand (*manus*), is the last member or terminal segment of the pelvic girdle, or lower limb. The fore limbs are more generally used for the support, and the hind limbs for the propulsion of the body. Hence, "the manus is commonly shorter and broader than the pes" (*Prof. Owen*), and but few animals use the foot (hind) for prehension or defense, save in flight. The exception to the rule that the hand is smaller than the foot is seen in the mole, or in the seal and walrus, which are deficient in the hind foot.

The foot is divided into three portions: (1) a group of more or less rounded bones called the tarsus or instep; (2) a row of long bones placed side by side in front of the tarsus—the metatarsus; (3) the phalanges of the digits, or the toes. The complete tarsus consists of seven bones—the astragalus, calcaneum, navicular, internal, middle, and outer cuneiform, and the cuboid. The chief variations in number are from six to eight. The general arrangement of these bones is in two rows—the proximal, or those articulating with the bones of the leg, and the distal row, those joining the metatarsus. The bones of the metatarsus usually correspond in number with the digits, and at their proximal ends the first, second, and third bones are supported respectively by the three cuneiform bones of the tarsus; the cuboid supporting the fourth and fifth. Upon each joint between the metatarsus and the toes are often found a pair of sesamoid bones, for the mechanical advantage of the tendon gliding over them. These are best seen in the mole and tiger. The digits never, except in abnormal instances, exceed five in number on each foot in any existing vertebrate animal above the rank of fishes, and in the class *Mammalia*, except the Cetacea, the number of phalanges is limited to two in the first digit, and to three in each of the other digits in both fore and hind feet (*Prof. R. Owen*). The hallux or great toe, though in man very strong, and one of the largest digits, is in many mammals entirely wanting, rudimentary, or inconsiderable in length. In many climbing animals it is considerably developed and has prehensile characteristics. This is well shown in the gorilla and orang. The other digits vary in number from one to five, as is illustrated respectively in the horse and the elephant (Fig. 2).

FIG. 1.—Fore foot of the mole. Hind foot.

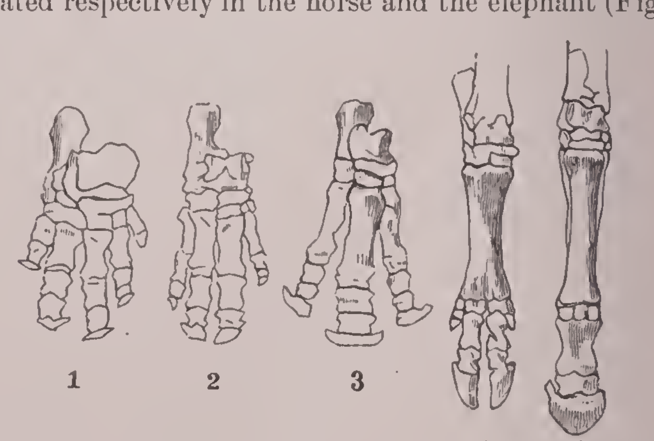


FIG. 2.—Simplification of the digits (after Owen): 1, foot of the elephant; 2, foot of the hippopotamus; 3, foot of the rhinoceros; 4, foot of the deer; 5, foot of the horse.

This modification of the digits is accounted for by their diminution and simplification in a definite order. Thus in a four-toed animal the great toe is wanting, as in the hippopotamus; in a three-toed animal the outer or smaller digit and the hallux—seen in the rhinoceros; in a two-toed animal, such as the cow or deer, both of those already mentioned and the second digit; and in the one-toed animal, such as the horse, only the third digit remains. That this is the order of disappearance is known by the absence of the corresponding metatarsal bone, each one of which has its definite attachment to one or more of the tarsal bones.

FIG. 3.—A side view of the bones of the human foot.

The Human Foot.—The human foot illustrates the general points of osteology already described, and at the same time is specially modified for its uses peculiar to man, the upright animal. And, as it might properly be stated, the foot is merely a hand modified for a base of structure to support the body. It is always larger than the hand, mainly in length and thickness; is also narrower, and of an ovoidal figure, the long axis reaching from before backward. The longest transverse diameter of the foot is the anterior one, in order to place on a broader base the support to the body, which is carried before the center of the body in walking. The solid parts of the

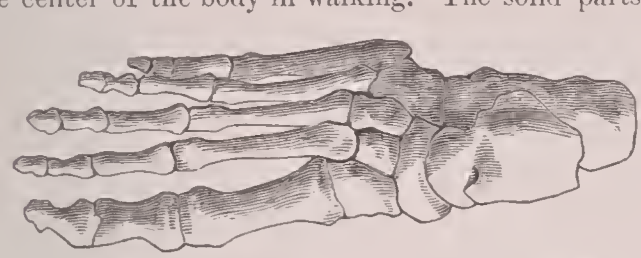


FIG. 4.—Skeleton of the human foot (original).

foot are more firm than the corresponding parts of the hand, and the movable parts of the foot less movable than those of the hand, in order to make the foot as perfect an organ as possible to give support and the surest and most facile locomotion of the body (Fig. 4).

The foot is constructed of two arches (Fig. 5), one from front to rear and another from side to side. The anteroposterior arch has for its points of support the heel and forward ends of the metatarsals, and the lateral the cuboid on the outside and the inner cuneiform on the inside. The segments of these arches, however, are not inflexible, but are made to yield among themselves, each a little, by the interposed cartilages. There is also a special arrangement, known as the Y-shaped calcaneo-scaphoid ligament, holding the keystone of the arch, which by its elasticity aids much in securing the beautiful spring of the body in motion. And as this ligament is attached to the heel-bone, it is called by the Germans the spring-bone.

One modification of the typical foot of mammals to the special structure of man is the angle of the plane of the foot

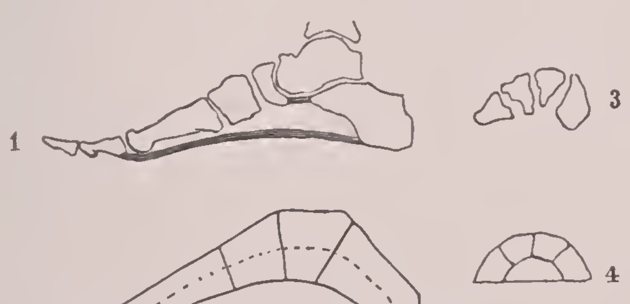


FIG. 5.—1, A view of the natural position of the bones forming the front arch of the foot; 2, a diagram of the same; 3, view of the bones of the side arch of the foot; 4, a diagram of the same. (1, 2, original; 3, 4, after Holden.)

and the leg. In the horse the angle averages 12°, while in man it is 90°. The design of this variation is to give as secure a leverage as possible to the muscles which must keep the weight of the body securely supported so far above the point of support, about two-thirds of the weight of the body being above the hips. Another peculiarity of the human foot is the great projection and horizontal direction of the heel, or, as some one has said, "ex calce hominem." In all animals it is the largest of the tarsal bones, as it is the lever for moving the foot; but in animals which assume the semi-erect attitude there is found either a greater development of this bone or larger development of the muscles of the "calf." Hence the small "calf" of the Negro is attributed by anatomists to the larger heel-bone, the smaller muscles being compensated by a longer lever at which to apply the power (Fig. 6).

The articulation of the great toe with the inner cuneiform bone is another special modification of the foot as pointing only to the erect position of the body. In the semi-erect apes, the gorilla especially, this joint is marked by a considerable degree of mobility, and the foot resembles a hand. (See Fig. 7.) But in man's foot the great toe is limited in its motions to simple flexion and extension; it lies parallel to the other toes, and is superior in strength, muscular and bony, to any of the other toes. In fact, each foot is to be viewed as a triangular pedestal of the body, supported respectively at the three angles of the great toe, heel, and little toe; so that the greatest muscular power is found furnished to each of these portions of the foot.

FIG. 6. — Illustrating the attachment of the muscles of the calf (1) of the human leg to the os calcis (2). (Original.)

The superior length of the great toe is a characteristic of the human foot; for while the second digit projects farther forward than does either of the other toes when the foot is viewed as a whole, yet the great toe itself alone, if compared with any other of the rows of phalanges, obtains the longest measure.

Although the foot, when compared with the hand in structure adapted to delicate operations, is very far inferior to it, yet it is astonishing what remarkable work can be accomplished by it when the hands are wanting. Thus instances frequently occur of persons who carve, write, and paint in a remarkable manner with their toes instead of fingers; so that the phrase "pes altera manus" is often not far from the truth.

Probably no organ in the body has been more abused by the fashion of its dress than has the foot. From time im-

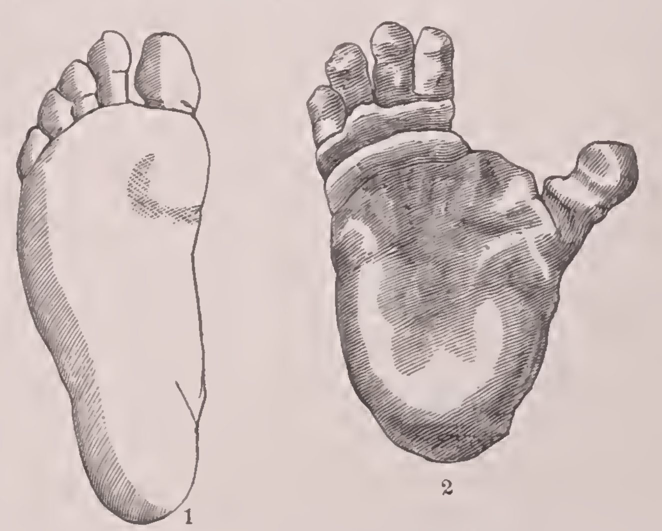


FIG. 7.—The plantar surfaces of the human and gorilla foot compared: 1, the human foot; 2, the foot of the gorilla (after Owen).

memorial, and by almost the entire human race, it has been squeezed into an unyielding case of hard leather, never so large as the foot itself when resting on the ground, and with a high appendage called the heel, from whence have come corns, bunions, *et id omne genus* of similar accessories of civilization. EDWARD HITCHCOCK.

Foot: the unit of lineal measure in common use in the U. S. and in Great Britain. All the nations of Europe and their colonies or dependencies employ, or have employed, a unit of length having in each language a name of the same significance as *foot* in English. This identity of name indicates similarity of origin, which was therefore unquestionably the length of the human foot. No two peoples, however, have agreed in the value assigned to their foot-measures. No two provinces, and hardly any two considerable towns even, have had the same foot. Nor have any of these measures corresponded very nearly with the presumed prototype; nearly every one of them being greater, and many of them much greater, than the average length of the foot of an adult man. In the volume of *Investigations in the Military and Anthropological Statistics of American Soldiers*, by Dr. B. A. Gould, published in 1869 among the memoirs of the U. S. Sanitary Commission, are given measurements of nearly 16,000 individual men, volunteers for the army, of various races and nationalities, 11,000 being white and the rest colored. The mean length of the foot was found for no nationality to exceed $10\frac{24}{100}$ inches, and for none to fall short of $9\frac{89}{100}$; the mean value for the total being $10\frac{058}{1000}$, or about one-twentieth of an inch above 10 inches. It is probable that the foot-measures in use in the later centuries have been in general entirely arbitrary. The account commonly given of the adjustment of the British standard yard in the year 1101 from the arm of the king, Henry I., is probably a true one; and the British foot is simply one-third of the British yard. But it was doubtless otherwise in the earlier ages. The ancient Greeks first used this measure, and their Olympic foot was said to have been determined by the length of the foot of Hercules. This, according to the best authorities, was about equivalent to $12\frac{14}{100}$ English inches. But there were among them other foot-measures materially differing from this. Thus the Macedonian foot was $14\frac{08}{100}$ inches; the Pythian, $9\frac{72}{100}$ inches; and the Sicilian, $8\frac{75}{100}$ inches. In more recent times the diversity has been almost endless. In Italy the foot was, not long ago, $11\frac{62}{100}$ inches in Rome, $13\frac{68}{100}$ in Milan, and $23\frac{22}{100}$ inches in Lucca. In France it was $9\frac{76}{100}$ inches in Avignon, $9\frac{79}{100}$ inches in Aix-en-Provence, $10\frac{57}{100}$ inches in Rouen, $14\frac{05}{100}$ inches in Bordeaux, while the *pied du roi* of Paris was $12\frac{79}{100}$ inches. In Switzerland it was $10\frac{52}{100}$ inches in Neuchâtel, $11\frac{33}{100}$ inches in Rostock, $11\frac{99}{100}$ inches in Basel, and $19\frac{21}{100}$ inches in Geneva. In the Spanish peninsula it was $10\frac{12}{100}$ inches in Aragon and $10\frac{96}{100}$ in Castile. In Germany it was $9\frac{25}{100}$ in Wesel, $10\frac{89}{100}$ inches in Bavaria, $10\frac{998}{1000}$ inches in Heidelberg, $11\frac{45}{100}$ inches in Göttingen, and $13\frac{12}{100}$ inches in Carlsruhe. And in the Netherlands it was $10\frac{86}{100}$ inches in Brussels and $11\frac{28}{100}$ in Liège. Alexander's *Dictionary of Weights and Measures* (Baltimore, 1850) gives more than 100 foot-measures, all differing from each other. In Barnard's *Metric System* (p. 354, Supplement) may be found a table containing no fewer than 292, all different. The confusion resulting from this great diversity was intolerable. The inconvenience caused by it in business transactions prepared the public mind of Europe early in the nineteenth century to receive with favor the new system of metrology called the metric, first definitely adopted in France in the year 1799. The foot has therefore ceased to be the legal unit of length throughout Europe except in Great Britain and Russia, and the meter has generally taken its place. The Russian unit of length, the *sagene*, was fixed by Peter the Great, after his sojourn in England in 1698, at exactly 7 British feet. The foot of the U. S. is identical with that of Great Britain, from which it is copied. In both countries the legal standard is properly the yard of 36 inches. The copy of the British standard, by which the U. S. standards were long adjusted, is a brass bar prepared by the celebrated Troughton, of London, to the order of Prof. F. R. Hassler, the first chief of the U. S. Coast Survey, and superintendent of the bureau of weights and measures at Washington. It is 82 inches in length, and the 36 inches between the twenty-seventh and the sixty-third divisions were taken as the prototype yard of the U. S. A copy of the British prototype, officially certified, has been substituted for the Troughton bar, and the standards furnished the several States are now carefully adjusted by this.

Foot: in music, a name or measure denoting the pitch of stops in an organ. In organ music, directions are often given for the use of 4-foot, 8-foot, or 16-foot stops. The meaning is this: the lowest note on the keyboard (C C) is assumed as the standard for such designations. Now, to produce the sound C C, an open pipe 8 feet long is required; its octave *above* will be given by a pipe 4 feet long; the double octave, 2 feet, and so on; and for the intermediate notes the pipes are properly graduated in length. A set of pipes of this description is therefore called "an *8-foot stop*" (as the *open diapason*, *dulciano*, *trumpet*, and several others). Such stops give the ordinary, standard, or concert *pitch*. If another range of pipes be added, sounding an *octave lower*, they will be of double length, and it will be called "a 16-foot stop" (as the *double diapason*, or *bourdon*). On the other hand, the *principal* is an octave *higher* than the open diapason; consequently, its pipes are only half as long, and it is called "a 4-foot stop." The *fifteenth*, in like manner, being tuned an octave above the principal, is "a 2-foot stop," its lowest pipe being that of length. In a large organ there are many stops belonging to each of these classes, the largest pipe of a 32-foot stop sounding C C C C. Revised by DUDLEY BUCK.

Foot, SOLOMON: lawyer and U. S. Senator; b. at Cornwall, Vt., Nov. 19, 1802; graduated at Middlebury College, Vt., in 1826; was principal of Castleton Seminary in 1826 and 1828; tutor in Vermont University in 1827; Professor of Natural Philosophy in the Academy of Medicine at Castleton, Vt., 1828–31; was admitted to the bar in 1831, and settled at Rutland, Vt. In 1833, 1836–38, and in 1847 was in the Vermont Legislature, and Speaker of its house for his last three terms. Was M. C. 1843–47, and U. S. Senator from 1850 to his death, at Washington, D. C., Mar. 28, 1866. Mr. Foot was for some years president *pro tempore* of the U. S. Senate; was a Whig in politics.

Foota Jallon: See FUTA JALLON.

Football: an athletic game of very ancient origin, believed by some to have been introduced into Great Britain by the Romans. From a rude pastime it has been developed into a scientific game, and has undergone considerable modification since the middle of the nineteenth century. There are two ways of playing football: one according to a code of rules adopted by the Football Association of England, formed in 1863, and the other according to rules long in force at Rugby School. The Rugby game has been changed and still further elaborated by the colleges of the U. S., among which it is very popular. Football surpasses every other game in its demand for a high combination of physical, mental, and moral qualities. The *American Rugby*, as the game played in the U. S. is called, requires a rectangular field 330 by 160 feet, the boundaries being plainly marked with white lines, as are also cross lines at intervals of 5 yards. Goal-posts, 20 feet high and 18 ft. 6 in. apart, with a cross-bar 10 feet from the ground, are erected at the middle of each end. The ball is about 12 inches long, elliptical in form, and made of inflated rubber protected by a covering of leather. Upon each side are eleven men who play offensively so long as in possession of the ball, losing it to their opponents only on penalty for illegal play, or by fumbling, or on failure to advance the ball 5 yards on four tries by running, or by kicking it. Points can be scored in three ways. Touching the ball down behind the opponent's goal line counts four points. This gives the privilege of a "place" kick for goal from a point in the field straight out from the touch down. Five points can be scored by a "drop" kick of goal from the field, and two more from a "safety" touch down. Two halves of forty-five minutes, with a rest of ten minutes between them, constitute full playing time. The players on each side are arranged in two distinct sets, the forwards and the backs, each set having highly specified duties. The forward line consists of the center, who usually puts the ball in play by snapping it back between his feet; a guard on each side, with duties indicated by the name; a tackle next to each guard, who in defensive play breaks through the opposing line to seize the player having the ball; and two end men freer in action. Immediately back of the center is the quarter-back, who receives the ball and places it in the hands of a third man before an advance can be made. Behind the quarter-back are two half-backs and a full-back, who do most of the running with the ball. A secret signal indicates to every player the projected play. Each year develops systematic play, by movements of surprise and stategy, by preconcerted interference in behalf of the runner, and by skillful blocking on the defensive side.

English Rugby is played with fifteen men on a side. It is slower and less scientific, but not so rough.

Association football is primarily a kicking game, the ball being advanced in that way, and by "heading," "breasting," and "kneeing" it. Five forwards, three half-backs, two full-backs, and a goal-tender play on each side. Goals are made by propelling the ball between two posts 8 feet apart and beneath a cross-bar 8 feet from the ground.

A. ALONZO STAGG.

Foote, ANDREW HULL: rear-admiral U. S. navy; b. at New Haven, Conn., Sept. 12, 1806; entered the navy as a midshipman Dec. 4, 1822; became a lieutenant in 1830, a commander in 1852, a captain in 1861, a rear-admiral in 1863. In the fall of 1861, the civil war being in progress, he was appointed to the command of the Western flotilla, then in course of construction for the purpose of opening the navigation of the Mississippi river. On Feb. 6, 1862, Foote took Fort Henry after a most obstinate fight; on the 14th of the same month engaged Fort Donelson, for an hour and a half, with four ironclads and two wooden gunboats, and so demoralized its garrison as to insure an easy victory over it by the army on the following morning; and on Apr. 7, after many a hard-fought action with its numerous batteries, received the surrender of Island No. 10, considered by the Confederates, next to Vicksburg, their most important stronghold on the Mississippi. Unfortunately, however, the flag-officer had received a severe wound at Fort Donelson, which from neglect had become so serious as to endanger his life, and he was forced to resign his command to another and return to his home. On June 16, 1862, he received the thanks of Congress and was made a rear-admiral, and on the 22d of that month was appointed chief of the bureau of equipment and recruiting. On June 4, 1863, he was ordered to relieve Rear-Admiral Dupont off Charleston, and on his way to his command was taken ill at New York, where he died on the 26th of the same month. He published *Africa and the American Flag* (1854). See his *Life* by James M. Hoppin (New York, 1874).

Foote, ARTHUR: composer; b. at Salem, Mass., Mar. 5, 1853. He received his musical education at home, studying composition at Harvard College under Prof. John K. Paine, and the piano and organ under B. J. Lang, of Boston. He has composed considerably, and has taken a place among the best of the composers of the U. S. His works include a cantata, *Hiawatha*, for baritone solo, male chorus, and orchestra: a trio for piano, violin, and 'cello; a string quartet; a suite for string orchestra, performed in 1887 at the London Symphony concerts; an overture, *In the Mountains*, produced Feb., 1887, by the Boston Symphony Orchestra, and other works of similar character.

D. E. HERVEY.

Foote, HENRY STUART: U. S. Senator; b. in Fauquier co., Va., Sept. 20, 1800; graduated at Washington College, Virginia, in 1819; was licensed to practice law in 1822; removed to Tuscumbia, Ala., in 1824; edited a Democratic paper, and in 1826 established himself at Jackson, Miss. He was presidential elector in 1844, and in 1847 was elected U. S. Senator, which position he held until 1852. He was elected Governor of Mississippi over Jefferson Davis in that year. In 1854 removed to California; in 1858 settled at Vicksburg, Miss., and at the Southern convention at Knoxville, Tenn., in May, 1859, spoke against disunion; was a member, however, of the Confederate Congress. He published *Texas and the Texans* (2 vols., Philadelphia, 1841); *The War of the Rebellion, or Scylla and Charybdis* (New York, 1866); *Bench and Bar of the Southwest* (St. Louis, 1876); and *Personal Reminiscences*. D. at Nashville, Tenn., May 19, 1880.

Foote, MARY (*Hallock*): artist and novelist; b. in Milton, N. Y., Nov. 19, 1847. She was married in 1876 to Arthur D. Foote, a mining engineer, and has since resided in California, Colorado, and Idaho, illustrating Western life and scenery by her drawings and her novels, among which are *The Led-Horse Claim* (1883) and *John Bodewin's Testimony* (1886). Poems by other writers have been illustrated by her, including Longfellow's *Skeleton in Armor* and *Hanging of the Crane*.

H. A. B.

Foote, SAMUEL: actor, wit, and dramatist; "the English Aristophanes"; b. at Truro in 1720; studied at Worcester College, Oxford (whence he was expelled for indiscretions), and at the Middle Temple, but indulged in gaming and other excesses until his considerable fortune was expended; and in 1744 he made his appearance as Othello at the Haymarket, but his success was small until he began to play in pieces written by himself; and his best characters were ludicrous imitations of living public men. From 1747 to 1767 he conducted the Little Haymarket theater without license, no one daring to enforce the law against him for fear of his terrible mimicry. He wrote at least twenty-seven plays of small literary merit, of which twenty or more have been printed. His humor was of the broadest and noisiest kind, and his jests were often practical ones, not without a large element of brutality. An accident which led to the loss of a leg was followed by paralysis, and the last years of his life were passed in great physical and mental distress. D. at Dover, Oct. 21, 1777.

Foote, SAMUEL AUGUSTUS, LL. D.: U. S. Senator; b. at Cheshire, Conn., Nov. 8, 1780; graduated at Yale College in 1797, and practiced law in Cheshire; was representative in Congress from Connecticut in 1819, 1823, and 1833; Speaker of the Connecticut Assembly in 1825–26, and Senator in Congress from 1827 to 1833. In 1834 was Governor of Connecticut, and in 1844 presidential elector. Senator Foote offered in the U. S. Senate the resolutions upon which the great debate occurred between Hayne, of South Carolina, and Webster, of Massachusetts. (See FOOTE'S RESOLUTION.) D. Sept. 16, 1846.

Foote, WILLIAM HENRY, D. D.: preacher and author; b. at Colchester, Conn., Dec. 20, 1794; graduated at Yale in 1816; taught at Falmouth and Winchester, Va.; studied in Princeton (N. J.) Theological Seminary; was licensed by the presbytery of Winchester Oct., 1819; preached in Virginia, and was in 1824 ordained pastor of the Presbyterian church at Romney; was agent of the central board of missions; prepared *Sketches in North Carolina* (1 vol., 1846) and *Sketches, Biographical and Historical, of the Presbyterian Church in Virginia* (2 vols., 1850–55). Was also agent for Hampden-Sidney College in Virginia, and Confederate chaplain at Petersburg, Va., during its siege, 1864–65. D. at Romney, Va., Nov. 28, 1869. *The Huguenots, or Reformed French Church*, was published after his death.

Foote's Resolution: a resolution introduced in the U. S. Senate Dec. 29, 1829, by Senator Samuel A. Foote, of Connecticut, instructing the committee on public lands to inquire into the expediency of limiting the sales of the public lands for a period to those which had already been offered for sale. The resolution was interpreted by Senators of the West as indicating a disposition on the part of Eastern Senators to check Western growth by limiting land sales. The Senators from the South joined with those of the West. In January Robert Y. Hayne, of South Carolina, declared that the East was inspired by the still further motive of desiring to limit the public revenue in order that the Government might be still further "centralized." Daniel Webster in his first reply to Hayne claimed that the growth of the Western States was chiefly due to the ordinance of 1787, which, as he declared, was drawn and introduced by Nathan Dane, of Massachusetts. Hayne declared that Dane was a member of the HARTFORD CONVENTION (*q. v.*), and made the fact a basis for the charge that the Eastern States favored a loose construction of the Constitution which tended to a centralized form of government. This brought out the second reply of Daniel Webster, in which, with remarkable cogency and eloquence, he not only expounded his own views of the nature of the government, but also those which he understood to be held by Hayne and his supporters. In the course of Webster's speech Hayne interrupted him by declaring that the right of nullification was not merely "a right of revolution, but a right of constitutional resistance." This assertion gave Webster the opportunity of replying at length to the new doctrine of nullification, and his speech is universally regarded as the most powerful presentation of the "national" theory of the government that had ever been offered. The effect of Webster's speech was so great that Calhoun in the following December resigned the vice-presidency in order that he might resume his old place in the Senate, and there meet his old antagonist. The great question involved in this discussion was nothing less than the constitutional right of secession. While Webster convinced the North that no such right existed, Hayne and Calhoun were equally successful in urging the opposite doctrine upon the South. As these doctrines, so fundamentally antagonistic, were held with perhaps equal earnestness and honesty, it was impossible to prevent collision whenever a dividing question of sufficient importance should present itself. The influence of the debate on Foote's resolution was to consolidate the North and the South in their respective opinions, and thus prepare the way for the civil war of 1861. See NULLIFICATION and SECESSION.

C. K. ADAMS.

Foot-rot: a disease of sheep which is rare in the U. S. Sometimes, when sheep from rocky pastures are taken to the English fen-country to fatten, the hoof grows too rapidly for its new conditions, and when it has become long it may become cracked and broken, or in part separated from the fleshy part of the foot. Sand and grass may lodge on the raw surface and lead to active inflammation. The cure is in removal of the foreign matter, clipping of the hoof, and the application of stimulants and caustics, with removal to a dry pasture.

Foppa, VINCENZO; painter; b. at Brescia, Italy, in 1400. He established a school of painting at Milan about the year 1445, which flourished up to the time of Leonardo da Vinci. Foppa was a great colorist and a proficient in perspective, being one of the first to introduce bold foreshortening in his compositions. His works are to be seen at the Brera Gallery in Milan. The painting of the Chapel of Peter Martyr

in Sant' Eustorgio, one of the most exquisite pieces of decoration of the fifteenth century, is also by him. D. in 1492.
W. J. S.

Forage [M. Eng. *forage*, from O. Fr. *fourage* (> Fr. *fourrage*), deriv. of *forrer*, forage, deriv. of *forre*, fodder, straw (> Fr. *feurre*), from Mediæv. Lat. *fo'drum*, from a Teuton. word; cf. O. N. *fōdr* : Eng. *fodder* : O. H. Germ. *fuolar* > Mod. Germ. *Fuller*. See FOOD]: food or fodder, food for animals. (See HAY.) The word is also used as a verb, when it means to collect supplies generally for both man and beast, from an enemy by force, from friends by impressment, but giving to friends receipts, to be paid ultimately.

Forage may be roughly divided into concentrated and coarse fodders. The more common concentrated foods are found in the cereal grains, the by-products of their manufacture into human food, and the ground cake left after extracting the oil from certain seeds as linseed, cotton seed, rape, colza, etc. The coarse fodders are found in the various grasses, the straws of the various grains, the stover of maize, and certain other plants, notably several members of the *Leguminosæ* (the clovers, alfalfa, pease, beans, etc.). A plant to be useful as forage must not only possess substances suitable for animal nutrition in a form readily assimilable, but must be palatable to the animal, free from acrid or poisonous qualities, and capable of easy cultivation and preservation. Coarse forage is usually preserved in the form of hay—i. e. sufficiently dried to prevent fermentation and decomposition, but a method of preservation in the green state (see ENSILAGE) furnishes a variety of available coarse fodders.

The daily ration of forage in the army of the U. S. is for each horse 14 lb. of hay and 12 lb. of grain, either oats, corn, or barley. For a mule the daily ration is 14 lb. of hay and 9 lb. of grain. The blades of Indian corn are used for forage in the absence of hay. The consumption of forage in a large and active army is enormous. Its weight, owing to the number of animals employed in military operations, is about four and a half times as great as that of the subsistence supplies for the same army. There were issued from the dépôt at Washington during the war of 1861–65 4,500,000 bush. of corn, 29,000,000 bush. of oats, and 490,000 tons of hay. Partial reports of the quartermaster-general show issues of forage during the war as follows:

22,816,271 bush. of corn, costing......	$29,879,314
78,663,799 bush. of oats..............	76,362,026
1,518,621 tons of hay, costing........	48,595,872
Total.........................	$154,837,212

The weight of these supplies in pounds was—

Corn............................	1,277,711,176
Oats............................	2,517,241,568
Hay............................	3,037,242,000

making a total of 6,832,194,744 lb.—numbers difficult to realize, but interesting as showing the magnitude of the operations necessary to provide and distribute these few items of the expenses of war. Revised by H. H. WING.

Foraker, JOSEPH BENSON: statesman; b. near Rainsborough, Highland co., O., July 5, 1846; at the age of sixteen enlisted as the first private in Company A, Eighty-ninth Ohio Infantry; his promotion was rapid, and at the battle of Mission Ridge he commanded his company. He was mustered out June 18, 1865, a captain, before he had completed his twentieth year. In 1869 he graduated at Cornell University, and afterward became one of its trustees; commenced practicing law in Cincinnati, O., in 1869; in 1878 became chief supervisor of elections for the southern district of Ohio; in 1879 he was elected to the superior court bench for five years; in 1883 he was nominated for Governor of Ohio by the Republican party, but was defeated by George Hoadly; in 1885 Judge Foraker was again nominated for Governor, and was elected; re-elected in 1887. He is one of the prominent leaders of the Republican party, and in 1896 was elected U. S. Senator to succeed Calvin S. Brice.

Fora'men (plural **Foram'ina**) [Lat., opening, deriv. of *fora're*, pierce, bore: Germ. *bohren*, bore: Eng. bore: Gr. φαράω, plow]: in anatomy, denotes in general any natural opening through a substance; more particularly an opening through a bone. It is especially applied to the bony passages through which the nerves and blood-vessels enter and leave the skull and spinal canal.

Foraminif'era [Lat. *fora'men*, *fora'minis* + *fer're*, bear]: a sub-class of Protozoa belonging to the Rhizopoda, and better named Reticularia. Most of the species are marine, and they are characterized by their ability to send out processes of protoplasm (pseudopodia) in the shape of fine threads, which unite together to form a network, whence the name Reticularia. A few species are naked, but most form a protective shell, often of a very complicated pattern, with either one or two large terminal openings or with numerous small pores for the protrusion of the pseudopodia. They were formerly regarded as organisms without a nucleus, but they are now known to possess one. The shell may be formed of carbonate of lime, of a horny-like matter, or of particles of sand cemented together. The shape and character of the shells are used in classification. In some it is simple, but in others it becomes very complicated by the budding of the protoplasm, the separate chambers thus formed being connected together. Many families and genera of recent forms have been described.

As fossils the Foraminifera hold an important position, as their shells build up vast beds of rock. Examples may be cited in the chalk cliffs of England, the nummulitic limestone of Egypt, and the Silurian beds of Russia. As fossils they occur in the lowest fossiliferous rocks (the celebrated *Eozoön* is probably not of organic origin), and a formation of chalk is taking place at the bottom of the ocean of to-day in the so-called globigerina ooze, which occurs at great depths. J. S. KINGSLEY.

Forbach, fōr'baakh: town of Lorraine, Germany; 12 miles N. W. of Saargemünd (see map of German Empire, ref. 6–C). It has coal mines and important manufactures. Near here (Aug. 6, 1870) the French under Frossard were badly beaten by the Germans under Prince Frederick Charles. Pop. (1890) 9,575.

Forbes, ARCHIBALD: war correspondent; b. in Morayshire, Scotland, in 1838; studied at the University of Aberdeen; served for several years in the Royal Dragoons; after 1870 he was war correspondent of the London *Daily News*; he accompanied the German army from beginning to the end of the Franco-German war; witnessed the close of the Commune; visited India during the famine of 1874; saw the Carlist war in Spain, the war in Servia 1876, the Russo-Turkish campaign in 1887, etc. Author of *Drawn from Life*, a military novel; *My Experiences of the War between France and Germany*; *Glimpses through the Cannon Smoke* (1880); *Soldiering and Scribbling* (1882); *Life of Chinese Gordon* (1884); *Life of the Emperor William of Germany* (1889); and *Havelock* (1890). D. in London, Mar. 29, 1900.

Forbes, EDWARD, F. R. S.: naturalist; b. in the Isle of Man, Feb. 12, 1815; began the study of medicine at Edinburgh in 1830; founded the Botanical Society of Edinburgh in 1836; visited Paris and the Mediterranean in 1837; was naturalist of the expedition to Lycia in 1841; Professor of Botany at King's College, London, in 1842; F. L. S. in 1843; assistant secretary to the Zoölogical Society in 1844; F. R. S. in 1845; Professor of Natural History at the School of Mines in 1852, and in the same year president of the Geological Society; Professor of Natural History at Edinburgh 1853. D. Nov. 18, 1854. Published *History of British Starfishes* in 1841, and, with Hanley, *History of British Mollusca* in 1853, besides other important works, including a great number of valuable papers upon zoölogical, botanical, and literary subjects. See *Memoir* by Dr. George Wilson and Archibald Geikie (London, 1861).

Forbes, JAMES DAVID, D. C. L., F. R. S.: physicist; b. at Colinton, near Edinburgh, Apr. 20, 1809; was Professor of Natural Philosophy in the University of Edinburgh in 1833; published *Travels in the Alps* in 1843; made discoveries in the laws of glacial motion, and in the phenomena of radiant light and heat in relation to polarization; and received the Rumford medal and that of the Royal Society of London. In 1860 became principal of the United Colleges in the University of St. Andrews. *Norway and the Glaciers Visited in 1851* was published in 1853; *A Tour of Mont Blanc and Monte Rosa* in 1855. He published many valuable papers, mostly upon questions in physics. *The Sixth Dissertation*, prefixed to the *Encyclopædia Britannica*, was his production. D. at Clifton, England, Dec. 31, 1868.

Forbes, JOHN: soldier; b. at Petincrief, Fifeshire, Scotland, 1710; became a physician, but gave up the profession to enter the army, and became lieutenant-colonel in the Scots Greys in 1745. After service in the German war was, Dec. 28, 1757, made brigadier-general in North America, and was adjutant-general in the expedition against Louisburg.

He commanded the expedition against Fort Duquesne, Pa., in Nov., 1758, and after it was abandoned by the French took possession and renamed the place Fort Pitt (now Pittsburg) in compliment to the English Prime Minister. D. in Philadelphia, Pa., Mar. 11, 1759.

Forbes, Sir JOHN, M. D., F. R. S.: physician and medical writer; b. in Banffshire, Scotland, Oct. 18, 1787; entered Marischal College in 1805, and was in the navy as assistant surgeon in 1807; received his M. D. degree in Edinburgh in 1817; practiced at Penzance and Chichester, England, and settled in London in 1840; became physician extraordinary to the Prince Consort the same year, and soon after to Queen Victoria; knighted in 1853; translated the works of Auenbrugger and Laennec on auscultation and percussion (1824); was an editor of the *Cyclopædia of Practical Medicine* (1833–35); published *Manual of Select Medical Bibliography* in 1835; and afterward edited the *British and Foreign Medical Review*. *Physician's Holiday, or a Month in Switzerland in 1848*, was published in 1849; *Memoranda made in Ireland*, in 1852; and *Nature and Art in the Cure of Disease*, in 1857. D. in London, Nov. 13, 1861.

Forbes, JOHN, LL. D., D. D.: a scholar of the Church of Scotland; b. in Boharm parish, Morayshire and Banffshire, Scotland, July 5, 1802. He was educated at Marischal and King's Colleges, Aberdeen, also studying at Göttingen and in Italy and Paris. After teaching for some years he was head master of John Watson's institution, Edinburgh, 1840–50, and of Donaldson's Hospital 1850–70, and Professor of Oriental Languages in the University of Aberdeen 1870–87. He published *Symmetrical Structure of Scripture* (1854); *Analytical Commentary on Romans* (1868); *Predestination and Free Will Reconciled* (1879); *Studies on the Book of Psalms* (1888); *The Servant of the Lord in Isaiah* (1890); *Universal Salvation* (1892). WILLIS J. BEECHER.

Forbes, JOHN COLIN, R. C. A.: artist; b. in Toronto, Canada, Jan. 23, 1846; entirely self-taught in art until the production of his first work. Subsequently studied for two years at the Royal Academy in London, England, and on the Continent, and upon his return to Canada painted *Foundering of the Hibernia*, *The Canon in the Royal Gorge*, *The Mount of the Holy Cross*, *The Glacier of the Selkirk*, *The Lily*, etc. He has painted portraits of the Rt. Hon. William E. Gladstone, presented by the Liberals of Canada to the National Liberal Club of London, England, Sir John A. Macdonald, Marquis of Dufferin, Lady Helen Blackwood, Sir Charles Tupper, Bart., and others. NEIL MACDONALD.

Forbes, JOHN MURRAY, D. D.: clergyman; b. May 5, 1807; graduated at Columbia College in 1827, and at the General Theological Seminary of the Protestant Episcopal Church in 1830; was for a short time assistant Professor of Ancient Languages in Trinity College, Hartford; ordained in 1830; in 1834 became rector of St. Luke's church, New York, and temporarily Professor of Pastoral Theology and Pulpit Eloquence in the General Theological Seminary. In 1844 and 1847 he represented the diocese of New York, as one of her clerical delegates, in the General Convention of the Church. In 1849 he entered the Church of Rome, and became shortly after pastor of St. Ann's Roman Catholic church in New York. In 1852 he was appointed by the Rt. Rev. Bishop of South Carolina his theologian in the plenary council of the Roman Church, held that year in the city of Baltimore, and in 1854 acted as theologian to the Rt. Rev. Bishop of Boston in the provincial council held in New York. He received the degree of S. T. D. by Vatican decree of Pope Pius IX. In 1859 Dr. Forbes returned to the Protestant Episcopal Church, in 1862 was restored to the exercise of his ministry, and in 1869 was appointed dean and permanent executive officer of the General Theological Seminary of the Protestant Episcopal Church in the U. S.—an office held by him until 1872. D. in 1885.

Forbes, STANHOPE A.: genre-painter; b. in England; contemporary. Pupil of Bonnat, Paris; associate Royal Academy, London; first-class medal, Paris Exposition, 1889. His pictures are remarkably good in drawing, and show great truth of observation in the treatment of effects of light in interiors. One of his best works is *The Village Harmonic* (1888), belonging to the corporation of Birmingham, England. Studio in London. W. A. C.

Forbidden Fruit: a name given in different countries to fruits which, according to tradition, represent the fruit of which Adam and Eve ate at the time of man's fall in Eden. One of these is a sort of thick-skinned orange (*Citrus aurantium*, var. *Paradisi*), which bears marks which are likened to tooth-marks. The skin is the part eaten; the pulp is very sour, but the skin is soft and pleasant to the taste. Another kind is a small shaddock (*Citrus decumanus*). Still another is the poisonous fruit of *Tabernæmontana dichotoma* of Ceylon, a tree of the order *Apocynaceæ*. This fruit appears as if bitten; hence the tradition.

Forcade-Laroquette, fōr'kaad'laa'rō'ket', JEAN LOUIS VICTOR ADOLPHE, de, LL. D.: b. in Paris, Apr. 8, 1820; a half-brother of Marshal Saint-Arnaud; became an advocate in 1841, and received the doctorate in 1846; became master of requests in 1852; director-general of forests 1857; director-general of customs revenues and indirect contributions, and councilor of state; minister of finance 1860–61; vice-president of the council of state 1863; minister of agriculture, public works, and commerce 1867; was one of the chief promoters of the Havre marine international exposition; minister of the interior 1868; was distinguished for parliamentary eloquence, and was an imperialist of liberal views. D. Aug. 15, 1874.

Force [O. Fr. *force*: Ital. *forza*: Span. *forza*, *fuerza* < Lat. **fortia*, deriv. of *fortis*, strong]: any action between material bodies by which they change, or tend to change, each other's condition. Every change of condition of a material body implies motion of some kind, either, first, of the mass (molar), or, secondly, of its component particles (molecular). Our earliest idea of force is derived from the resistance of matter to the touch. Matter itself becomes known at the same time; and as we perceive it to have extension, we acquire simultaneously the idea of space. Matter is whatever occupies space. Nothing is known of force except as a cause producing, or tending to produce, motion or change of motion in matter. Force, therefore, is the efficient cause of all physical phenomena, including not only those commonly called mechanical, but also those attendant on heat, light, electricity, and chemical action. Mechanical forces are such as produce their effects upon masses of measurable magnitude directly. They are distinguished as dynamical (producing actual motion; see DYNAMICS) and statical (held in check by opposing forces; see STATICS). Statical forces may be compared with each other by means of the efforts or pressures they exert, which may be measured by a spring balance or by opposing them to known forces through an intervening lever. But as static forces produce motion if opposed by resistances less than themselves, such forces may also be measured by their relative power to generate motion when all resistance is removed. A heavy body resting upon a support exerts a pressure which is due to the force of gravity acting statically. If the support be removed, the body falls. We have the means of ascertaining experimentally the velocity imparted by gravity to a falling body in a unit of time; and this furnishes us with a natural standard for measuring other forces. Observation again shows that the pressure exerted by a mass in consequence of gravity is proportioned to the mass. It shows, however, also, that every mass of matter, whether small or great, falls, if unsupported, with the same velocity. By experiments made with Atwood's machine, and in other ways, it is found that if the force which acts upon the same mass is increased or diminished, the velocity generated is also increased or diminished proportionally. It may therefore be said, briefly, that forces are proportional to the masses moved and to the velocities generated at the same time—in other words, that force is as the product of velocity into mass. This product is called moment. Putting, then, f for force, p for pressure, m for mass, and v for velocity, the result is $f \propto p$, and $f \propto mv$. Moment as well as pressure may accordingly be taken as the measure of static force; but in this expression v represents what is called a *virtual* and not a real velocity, being that which the mass m would take on if the system were to be set in motion.

When a force acting continuously produces motion or overcomes a resistance through space, it is said to do work. If the resistance is simply the inertia of a constant mass, the work done will consist in accelerating velocity. If the resistance is external (as of friction opposing motion on a horizontal plane), the work done will consist in transferring the mass from one point to another in space. In either case the measure of the work will be the force acting or the resistance opposing, multiplied by the distance passed over. For external resistances, as of friction just mentioned, this is self-evident. For the resistance of inertia it may be shown to be true by considering the case of gravity. The increments of velocity imparted by gravity in successive equal instants of time to a body falling from rest are equal; but the minute spaces passed over in these successive instants, being proportional to the successive actual velocities, form an arithmetical series. (See FALLING BODIES.) The sum of this series gives the total space fallen, which is $\frac{1}{2}vt$. Now, mg being the measure of the static force of gravity, $\frac{1}{2}mgvt$ represents the work of gravity in putting a body into motion with the velocity v. And as $gt = v$, we obtain finally for work (W), $W = \frac{1}{2}mv^2$. Any other constant force, as f, greater or less than gravity, will generate the velocity v in a time proportionally less or greater; but the work done will in all cases be the same, and will be independent of both force and time. For, as $ft = v$, and as v is, by hypothesis, constant, ft is constant also, and $W = \frac{1}{2}mfvt$ is invariable, whatever be the value of f. In like manner, the work which may be done by the moving mass in overcoming resistance to its motion is equally independent of time, while the space through which it may move in expending the force accumulated in it will be inversely as the resistance it encounters. Thus a heavy ball rolling over smooth ice, being but slightly retarded by friction, will roll very far, but a hammer or bullet suddenly arrested will exert an enormous and even destructive pressure.

We thus see that the power of a moving mass to do work is proportioned to the square of the velocity of motion, while the power of a simple pressure to hold in check an opposing pressure is proportioned to the virtual velocity only. For distinction, the product mv^2 is called the *vis viva*, the living force, or the kinetic energy, and mv the moment. By *energy* is meant the capacity of a body to do work. This may depend on its position or condition, and is then called *potential energy*. The body is doing no work, but may be made to do work by some change in one or both the respects mentioned. A clock-weight wound up, the mechanism being at rest, is an example of energy of position. Gunpowder is an example of energy of condition. *Actual* energy is that exercised by a moving mass, and is equivalent to living force. A pendulum at the end of its swing possesses only potential energy, and in the middle of the swing only actual energy.

Thus far we have confined ourselves to the relations of force and energy in mechanics. We now proceed to consider them in their wider significations. The forces of nature which are characteristically different from each other may be stated as follows: 1, gravitation; 2, molecular force; 3, chemical affinity; 4, heat and light; 5, electricity; 6, vital force. Gravitation, which is the attraction between bodies at a distance, is proportional directly to the product of the two masses, and inversely to the square of the distance between them. Molecular force is the attraction between the particles of bodies, and is manifested in solids and liquids by their cohesion and elasticity, and in liquids additionally in capillarity and osmose. Chemical affinity resembles the force last named in acting at insensible distances, but differs in being manifested only between unlike substances. Heat is supposed to be a mode of vibratory motion actuating the molecules of every material substance. Elevation of temperature is explained as an increase in the energy of the vibrations and an enlargement of their amplitude, whereby the volume of the combined mass is expanded, and ultimately the cohesion and even the affinities of its molecules are overcome. These vibrations are supposed to be propagated from body to body by undulations in an exceedingly rare medium filling all space, called ether. When these undulations fall within certain definitely assigned limits as to length, they have power to affect the retina of the eye, and thus give rise to the phenomena of light. Electricity is a very energetic force, the physical theory of which is still unsettled. It produces, according to circumstances, attractions and repulsions between masses and between molecules. Magnetism is but a form of electrical action. Vital force is more obscure as to its manner of action than any other; and it is even denied by many physicists and physiologists that any such distinctive force exists, all the phenomena ascribed to it being attributed to electricity, chemical affinity, and heat. There is no doubt, however, that there exists in the nervous centers of living animals a certain power which can cause contraction of the muscles of the body by exciting the proper nerves. The velocity with which this message is transmitted is by no means great, not exceeding 20 or 30 meters per second. When a whale is struck by a harpoon, such is the size of the animal that quite an interval elapses before the brain can be informed of the fact and can put the muscles of the tail in operation; so that before this effect is produced the whalers have time to retreat.

Having thus classified forces, we may still further distinguish the kinds of energy dependent on them as follows: Kinetic energy exists in the four forms, A, of bodies in motion; B, of radiant heat and light; C, of electricity in motion; and D, of absorbed heat. Potential energy may be, E, position of the body in regard to gravity or other force acting at a distance; F, molecular separation; G, chemical separation; and H, electrical separation. In the first four of these forms work is obtained directly from the motion of the body or its molecules; in the second four it is derived from an alteration of its condition.

Whenever energy in one form disappears, it reappears in another, and this property is known as the transmutation of energy or the correlation of forces. (See ENERGY.) For example, the energy of a moving body suddenly arrested in its motion is converted into heat; the energy of an electric current may be transformed, in an electro-dynamic engine, into kinetic energy or into potential energy of chemical affinity in electrolysis. In general, such transformations are not from one form of energy into a single other form only. The moving body arrested expends some part of its energy in molecular separation (fracture of the opposing body), some part in giving motion to the fragments, and the rest in heat. The energy of the electric current is distributed between mechanical motion, heat, and chemical separation. But if in every such case we could collect and reunite all these fractions of distributed energy, we should find their sum just equal to that which has disappeared; and this leads us to one of the grandest generalizations of modern times, the doctrine of the persistence of force, or the conservation of energy, expressed in the proposition that energy, like matter, is indestructible, so that, however its form may change, its total quantity is forever constant.

With the demonstration of this doctrine a fatal blow has been given to an illusion which from the earliest times has exercised a singular fascination over many ingenious minds—the belief in the possibility of a perpetual motion. By this was meant, not the eternal persistence of motion in a body which encounters no resistance whatever—for in this sense the doctrine of the conservation of force is also a doctrine of perpetual motion—but the delivery at one part of a mechanical contrivance of a greater amount of kinetic energy than that which is applied at another to set the contrivance in operation. See PERPETUAL MOTION.

Measure of Forces.—In order to compare quantities of any kind it is necessary that we have some definitely fixed units of measure. By the aid of such units the relative magnitudes of quantities of the same kind are expressible in abstract numbers. And when quantities of different kinds are in the relation of dependent variables, the laws which connect them may be expressed by comparing the abstract numbers which denote their relations of magnitude among themselves. For this purpose it is necessary to take as a starting-point some state of the related quantities of which the conditions are definitely known. Take, for instance, the law of pressure and volume in gases, commonly called the law of Mariotte. If the elasticity of air compressed in a cylinder by a force of 20 lb. to the sq. inch maintains the piston at the height of 4 feet, 40 lb. to the sq. inch will reduce this height to 2 feet. We have here a variety of units, and the numbers are unnecessarily large. It would be simpler to say that if under a pressure of 1 (unit of force) the air compressed occupies 2 units of volume, then a pressure of 2 units of force will reduce it to 1 unit of volume. It is therefore desirable that, in order to compare with facility the relations of quantities of different kinds, the units shall be so chosen as to have the simplest possible relations between each other.

The centimeter, gramme, and second have been recommended by the British Association for the Advancement of Science as fundamental units on which to establish other unit measures of quantity and energy for physical purposes, called, therefore, derived units. These fundamentals are sometimes referred to as the "B. A. units" or the "C. G. S. units" (centimeter, gramme, second).

Since, when bodies move uniformly, $s = vt$, the unit of velocity will be naturally that found by making s and t equal to the fundamental units C and S; that is, it will be that velocity which will carry a body 1 cm. in 1 second. In the same way, if a be put for acceleration, $v = at$; and putting v and t each unity, a is the force required to generate a velocity of 1 cm. in 1 second. The unit of mass is deduced from the two forms above given for expressing statically the force of gravity—viz., $mg = w$. This gives $m = w \div g = w \div 981$ cm., this last expressing nearly the accelerative force of gravity. If $w = 1$ gramme, m is a little over a milligramme. As all the derivative denominations of this system are decimal multiples of the unit, the introduction of an incommensurable divisor, as in this case, is an incongruity to be regretted, but it is unavoidable. Since g, however, varies in different latitudes (though only slightly), it is advisable to employ, as has been proposed by Sir William Thomson, the value of g at Paris, which is 980·87 cm. Hence putting $m = 1$ and $w = 1$, the unit of mass is 1 gramme divided by 980·87. The unit of force $f = ma$ is found by making $m = 1$ and $a = 1$, when $f =$ the force required to produce in the mass of 1 gramme the unit of acceleration, which, as above, is 1 cm. in 1 second. But the mass of 1 gramme is, as we have seen, the weight of 1 gramme divided by 980·87. Hence the unit of force, compared with gravity, is $\frac{1}{981}$ part as great, or, expressed as weight, is slightly over a milligramme. This unit of force is called a DYNE (*q. v.*). The unit of work, $W = fs$, is found by making f and $s =$ unity, and is therefore 1 dyne acting through the space of 1 cm. This is called an *erg*. The higher denominations in this system are formed by decimal multiplication; and inasmuch as, in consequence of their minuteness, the quantities which we deal with every day exceed them a thousand or a million times, a short mode of writing and naming these multiples has been adopted; thus: a gramme being 981 dynes and a kilogramme 981,000 dynes, a mass of 1,000,000 dynes would not greatly exceed a kilogramme. And 1,000,000 dynes is written 1×10^6 dynes, or *one dyne-six*. So the circumference of the earth, being 4,000,000,000 cm., is written 4×10^9 cm., and is read *four centimeter-nines*. If division is to be expressed, the ordinal numbers are used. Thus 1 milligramme $= \frac{1}{1000}$ gramme is written 1×10^{-3} gramme, and read *one gramme-third*. This system of units has not been generally accepted as yet in the scientific world. Still less has it been introduced into the arts of industry. For the units now generally employed in the U. S. and in other countries for computing the force of engines, water-powers, or animals, or calculating the work performed by any one of these motive-powers, see UNITS.

Passing from mechanical to physical units, the most important of all, whether in its scientific or its industrial relations, is the unit of heat, which is the amount of heat necessary to raise the temperature of 1 kilog. of water one degree centigrade. The number of units of work necessary to generate this amount of heat is called the *mechanical equivalent of heat*. Much careful labor has been expended in the attempt to determine this important constant (see HEAT). The value commonly received is 423 kilogrammeters, or 423 kilog. raised 1 meter high. The corresponding value for British units and the Fahrenheit thermometer is 772 foot-pounds, or 772 lb. raised 1 foot high. The derived unit of heat on the B. A. system would be the amount necessary to raise the temperature of 1 gramme of water through one degree centigrade. The mechanical equivalent of this would be 42,300 grammes raised 1 centimeter, or 42,300 gramme-centimeters, or centigrammeters; which, in ergs, would amount to 41,491,000, or 41 erg-sixes + 491 erg-threes. For electrical units, see ELECTRICITY.

Sources of Energy.—The immediate sources of energy in our planet are numerous, embracing, as sources of kinetic energy, the radiation of the sun, the motion of air and water, and the muscular force of animals; and, as sources of potential energy, water accumulated above the general level in lakes and rivers or lifted by the tides, unequal distribution of temperature on the earth, wood, coal, native sulphur, and other combustible minerals, and food as the source of kinetic muscular force. All these, however, except the tides and some unimportant cases under the head of combustibles, are originally derived from the great source first named—viz., the solar radiation. The internal heat of the earth, sometimes exhibited in volcanic action, is a source of energy practically unavailable; but its gradual decline, causing contraction of the interior mass, permits the energy of gravitation occasionally from being potential to become active, and to manifest itself in earthquakes. Tidal action requires some explanation. To an observer on the moon the tidal wave, if visible, would appear as a mass of water nearly at rest, under which the earth is revolving like a car-wheel under the brake. The energy therefore is derived from the motion of the earth, and since this energy is continually converted by friction into other forms, there is a constant drain upon its source; or, in other words, it is continually making the earth turn more and more slowly. This effect is of course exceedingly slight, but it is supposed to account for the astronomical phenomenon known as the secular acceleration of the moon's mean motion, the moon appearing to move faster since the earth moves more slowly. The ultimate result will be that the time of revolution of the earth around its axis will at length equal the time of revolution of the moon around the earth, or the latter will always turn its same face toward the moon. Now, if the moon ever contained a liquid like our ocean, a similar effect would be produced on it, only in a much more marked manner, owing to the larger size of the earth. The necessary result would be that which has actually occurred—that the times of revolution of the moon around its axis and around the earth would be equal.

Although in a system of bodies in communication with surrounding objects the total amount of energy is always constant, yet all of it is not available to do work. For instance, if two bodies, one warmer than the other, are thus isolated, the heat passes from the first to the second, and is thus able to do work; as soon, however, as they both attain the same temperature the available energy is exhausted, and although their actual temperature may be very high, they have no power of doing work until brought in contact with some cooled body. This available energy is known as the *entropy* of the system. In any actual case a considerable portion of the energy of a body is lost by being converted into a form from which we can not reconvert it into work. Thus a heated body when used as a source of energy begins at once to lose its heat by radiation, by heating the surrounding air, and by conduction through its support, the energy being here converted into heat but little above that of surrounding bodies, and therefore not readily convertible into work. A similar loss takes place with an electrified body, since there is no perfect non-conductor of electricity. In the case of motion we can not avoid the resistance of the air or of friction; and often some surrounding bodies being set in vibration, a portion of the energy is converted into sound. The effect of all this is slightly to warm the various bodies moved, and thus again the energy is brought into a form from which it can not easily be brought back. This is what is known as the dissipation of energy.

The grandest application of these laws is in astronomy to the determination of the source of energy in the solar system. We have already seen that the effect of a liquid on a satellite is to act as a brake to alter the time of rotation, until it is finally rendered the same as the time of revolution in the orbit, so that the same face shall always be turned toward the primary. The planets would also be affected in the same way, both by their satellites and by the sun itself; and although the problem becomes one of great complication, probably the final result would be the conversion of nearly all the kinetic energy of rotation into heat, which would eventually radiate into space. The far greater energy derived from the sun is also rapidly passing off into space. The total amount received by the earth, great as it is, is almost infinitesimal compared with the amount radiated into space, and thus lost. This energy is estimated at the surface of the sun to be equivalent to 7,000 horse-power for each square foot of surface. This amount of energy is so great that if the sun were a mass of burning coal, it would be wholly consumed in 5,000 years, and in 5,000 years more would have cooled down 9,000° C. Since geology proves that for hundreds of thousands of years the temperature of the earth has been about the same as at present, evidently chemical combination is not sufficient to account for this vast fund of energy. The nebular hypothesis assumes that the matter of the solar system was originally distributed through space, and the planets and sun formed by its condensation. Here there would be an enormous source of energy, since the potential energy due to the distance of the particles would by the force of gravitation become kinetic in their approach to each other. On making the calculation, however, the energy thus set free proves to be as much too great as the other was too small; and this theory also must be rejected. The view now held with regard to the source of the sun's heat is that it is due simply to its contraction. The mass of the sun is so great that on the most unfavorable supposition the heat set free by the diminution of potential energy due to its contraction would supply the present loss for 7,000 years before the whole mass would have altered its temperature by one degree centigrade. Still, enormous as this supply is, it must eventually be exhausted, and then, by the dissipation of energy, be finally converted into radiant heat and diffused through space. The final result, therefore, would be that all bodies would assume the same temperature; there would be no further source of energy; physical phenomena would cease, and the physical universe would be dead. Such, at least, is the present view of this stupendous question. E. C. PICKERING.

Force, PETER: historian and journalist; b. at Passaic Falls, N. J., Nov. 26, 1790. In 1820 he commenced the publication, in Washington, of *The National Calendar*, a volume of national statistics, which he published annually until 1836. He also published (1823–30) a political newspaper, *The National Journal*, which was, during President J. Q. Adams's administration, the official organ. By desire of the Government he undertook in 1833 the preparation of a documentary history of the American colonies, a labor to which he devoted thirty years, during which time nine folio volumes were published, entitled *American Archives*. While thus engaged he accumulated a valuable library relating to early American history, consisting of books, documents, manuscripts, maps, etc., which were purchased by the U. S. in 1877 for the Congressional Library. D. at Washington, D. C., Jan. 23, 1868.

Force Bill, The: the name popularly applied to the bill introduced in the U. S. Congress Mar. 15, 1890, providing for the Federal control of elections. It passed in the House July 2, went to the Senate, and, after a bitter struggle, was forced aside without a decisive vote on Jan. 17, 1891. The Democrats who opposed it made the bill an important issue in the congressional and presidential campaign of 1892.

Forcellini, fōr-chel-lee'nēē, EGIDIO: Latin lexicographer; b. at Féner, near Feltre, in the Venetian territory, Aug. 26, 1688. The poverty of his parents deprived him of early advantages, but having entered the seminary of Padua, he by his marked abilities and devotion attracted the notice of Facciolati, then director, who soon engaged his aid in carrying out his own designs for improving the Latin dictionaries then in use. In 1705, under the direction of his teacher, Forcellini began the revision of the book called *Calepinus* (see FACCIOLATI), and finished it at the end of 1718. Facciolati meantime had conceived the plan of a complete dictionary of the Latin language, which should comprise all the words of existing authors, as well as those found in inscriptions and on medals. The execution of this great work devolved entirely upon Forcellini, and to him this credit belongs, though he enjoyed throughout the whole period the counsel and supervision of his old teacher. A brief memorandum by Forcellini states that he began the task at the end of 1718, and worked three and a half years on the letter A. In 1724 he was called away to be Professor of Rhetoric and director of the seminary at Ceneda, and was obliged to suspend work on the dictionary till his recall to Padua in 1731. From this time he labored for eleven years without interruption, for the next eleven, with more or less hindrance, till the completion in 1753; two years were given to revision, and eight years to the transcription, which was finished Nov. 13, 1761. D. at Padua, Apr. 4, 1768, one year before Facciolati, and three years before the publication of the work that had occupied nearly forty years of his life. The title-page sets forth fairly the relation of the two editors: *Totius Latinitatis Lexicon Consilio et cura Jacobi Facciolati opera et studio Ægidii Forcellini alumni Sem. Patav. lucubratum.* The work, after lying ten years, was published in 4 vols. folio, under the care of Cognolati, who wrote the preface. A new edition appeared in 1805, and a third, revised with additions by Furlanetto, Padua, 1823–31, 4 vols. 4to. The newest edition by De Vit, with Onomasticon, 1858 ff. An edition with the Italian explanations translated into English was issued by G. Bailey, London, 1828, 2 vols. 4to. See J. B. Ferrari, *Life of Forcellini*, (Padua, 1792). Revised by ALFRED GUDEMAN.

Forceps [from Lat. *forceps* for **formiceps*; *formus*, warm + *ca'pere*, take]: in surgery, an instrument for seizing, and often for removing, bodies which can not conveniently be seized by the hand. Forceps are of many forms. Special kinds are used for special purposes, as for drawing teeth, for cleansing sores, for seizing a bleeding artery, for extracting bullets, for assisting in the birth of the fœtus, and for many other uses.

Forchhammer, fōrkh'haā-mer, JOHAN GEORG: geologist; b. at Husum, Schleswig, July 26, 1794; became a distinguished geologist, mineralogist, and chemist; was the associate of Oersted, and long held the chair of Geology at Copenhagen; author of works on the geology of Denmark (1835), of Scandinavia (1843), and a manual of chemistry (1834–35). D. at Copenhagen, Dec. 13, 1865.

Forchhammer, PAUL WILHELM: Greek archæologist and mythologist; b. at Husum, Schleswig, Oct. 23, 1803; privat docent in Kiel 1828; professor extraordinary in 1836; professor ordinarius in 1843. His writings are chiefly the result of his extensive travels through Greece, and pertain particularly to topography and Greek mythology. In the treatment of the latter subject he persistently advocated throughout his long life a purely symbolical interpretation of Hellenic myths and legends, regarding them as the anthropomorphized embodiments of aquatic phenomena. This theory, which has justly not been received except in some minor details, is brought out with great learning and remarkable ingenuity in all his publications, of which only a few can be mentioned: *Achill* (1853); *Daduchos* (1875); *Wanderings of Io* (1880); *Erklärung der Ilias*, on the basis of the topographical features of the plain of Troy (1884); *Mykenæ* (1881); *Hellenika*, vol. i. (no more published); *On Aristotle's Poetics*, etc. D. at Kiel, Jan. 9, 1894.

Forcible Entry and Detainer: in law, a forcible entry consists in an unlawful entry upon lands or tenements, accompanied by the exercise of force or by the use of such threats and menaces as overawe those rightfully in possession, and prevent their resistance. Forcible detainer consists in wrongfully keeping possession of lands or tenements by force and threats, whether the original entry was forcible or peaceable. Entry and detainer are usually included in the same act. The remedy for a forcible entry and detainer is twofold, the law affording both a criminal and a civil remedy. The common-law remedy is criminal in its nature, while the statutes afford a civil remedy. The sole object of the civil action is the recovery of the possession which has been invaded, the judgment being that the plaintiff have restitution of the premises of which he has been unlawfully deprived. The civil and criminal remedies can not both be pursued in the same proceeding.

From the time of the Norman Conqueror until the statute of 5 Rich. II., c. 8, the common law of England permitted one having a right of entry to enter with force and arms, and to retain his entry by force when his entry was lawful. But experience showing this to be prejudicial to the public peace, as it enabled the powerful to tyrannize over their less fortunate neighbors, it was deemed proper to restrain by severe laws all persons from themselves taking possession by force, and the statute referred to was enacted. This statute has been followed in England by others of like import, and similar statutes have been enacted in the U. S. These statutes generally declare that "no entry shall be made upon lands except in cases where entry is given by law, and that in such cases it shall be made only in a peaceable manner, not with strong hand, nor with multitude of people." In most of the States jurisdiction over the action is conferred upon the justices of the peace. They have no jurisdiction, however, in cases where the title to real property is in question. But the limitation of the jurisdiction of justices of the peace to actions where the amount in dispute does not exceed a certain amount does not deprive them of jurisdiction in actions of forcible entry and detainer.

1. In order to maintain the action, the complainant must show that he was in the actual and peaceable possession of the premises at the time of the ouster complained of. The action does not involve the right to possession, but only the fact of possession.

2. The person who may bring the action is the person who was deprived of the possession. A landlord can not bring the action while his tenant is in possession, but the action should be brought by the tenant. In some States, however, the statute gives the landlord the right to maintain the action against his tenant.

3. The person against whom the action may be brought is the person who is in possession at the time of the commencement of the action. It may be maintained against the representatives of the disseizor, and against those in possession under him.

When entry is made by one who seeks to justify his act by a plea of ownership, as by a landlord against a tenant holding over after his term, it is generally held that the ten-

ant can not bring a private action for the offense, although the landlord is punishable for the violation of the peace.
HENRY WADE ROGERS.

Forcing: among gardeners, properly the production of any fruit or flower out of its proper season by the judicious use of hot or cold frames, glass houses, stimulating ammoniacal fertilizers, and other like appliances. The term can not be extended to the growing, by similar means, of exotic, and especially tropical, fruits or plants in an uncongenial climate. The system pursued in the orchard-house is not, properly speaking, forcing. It is simply the production of another climate, the imitation of the climate in which the plant naturally grows, the furnishing of the necessary conditions for the life of the plant. Fruit-trees, especially cherry-trees, are often forced, in the true meaning of the word. Very diminutive trees may be seen richly loaded with fruit. The Chinese and Japanese are great masters in the art of forcing. Certain varieties of fruit-trees are by gardeners considered as particularly suitable for forcing.

Forcite: See EXPLOSIVES.

Ford, JOHN: English dramatist; b. at Ilsington, Devonshire, in 1586; entered the Middle Temple, London, Nov. 16, 1602, and appears to have followed the legal profession with some success. He produced, alone or in conjunction with other dramatists, a dozen or more plays, of which only nine are extant, including the two powerful but morbid tragedies, *The Broken Heart* and *'Tis Pity She's a Whore.* D. about 1640.

Ford, LEWIS DE SAUSSURE, M. D., LL. D.: physician; b. in Morristown, N. J., Dec. 30, 1801: graduated from the College of Physicians and Surgeons of New York City in 1822; in 1832 assisted in organizing the Medical College of Georgia, at Augusta, an institution in which he held the professorships of Chemistry and Practice of Medicine. He was twice mayor of Augusta; received the degree of LL. D. from the University of Georgia in 1868. He contributed valuable essays on paroxysmal fevers, from 1836 to 1845, to *The Southern Medical and Surgical Journal.* D. in Augusta, Ga., Aug. 21, 1883. C. H. THURBER.

Ford, WORTHINGTON CHAUNCEY: statistician; b. in Brooklyn, N. Y., Feb. 16, 1858; educated at Columbia College; served on the editorial staff of the *New York Herald*; chief of the U. S. bureau of statistics from 1893 till 1898; author of *Wells's Natural Philosophy* (1879); *The Standard Silver Dollar* (1884); *American Citizen's Manual* (1882); *Letters of Joseph Jones* (1889); *Writings of Washington* (14 vols., 1889–92); *Spurious Letters of Washington* (1889); *Washington as an Employer and Importer of Labor* (1889); *The United States and Spain in 1790* (1890); *General Heath's Orderly Book* (1890); *Washington Wills* (1891); *Letters of William Lee* (3 vols., 1891); *Correspondence and Journals of Samuel B. Webb* (2 vols., 1892). C. H. THURBER.

Foreclosure: See MORTGAGE.

Forefathers' Day: the anniversary of the landing of the Pilgrims at Plymouth, Mass., in 1620. The event occurred on Monday, Dec. 11, *old style*. The day was first publicly and formally commemorated in 1769, when seven gentlemen of Plymouth, on Dec. 18, formed the Old Colony Club to celebrate "the landing of our worthy ancestors in this place." Eleven days were erroneously added to the recorded date, in order to accommodate the event to the Gregorian style, hence the date Dec. 22 came to be generally accepted. The Gregorian calendar was not adopted in England until 1752, when it was necessary to add eleven days to *old style* in order to correct the error. But in 1620 the addition of ten days only was necessary to correct the error, the same that had been provided for in 1582 by Pope Gregory when the Gregorian calendar was substituted for the Julian. It follows that the date of landing, *new style*, was Dec. 21 instead of Dec. 22, which is usually celebrated. The Old Colony Club disbanded in 1773, but the town of Plymouth voted to keep up the celebration, the usual form being a church service and anniversary service. From 1780 to 1794 exercises were suspended. In 1819 the Pilgrim Society was formed. The formation of the New England Society of the city of New York, May 6, 1805, "to commemorate the landing of the Pilgrim Fathers on Plymouth Rock, to promote friendship, charity, and mutual assistance, and for literary purposes," seems to mark the beginning of the observance of Forefathers' Day outside of New England. The annual meetings of this society on Dec. 22 (Forefathers' Night) have acquired wide fame. Numerous New England societies have been formed in all parts of the U. S., so that the celebration of the day is likely to become national.
C. K. ADAMS.

Foreign Attachment: a process of attachment by which the property of a foreign or absent debtor in the hands of third persons, or debts due him from them, may be levied upon for the discharge of his indebtedness to a suing creditor. This form of procedure has existed in England from a very remote period, but only in a few of the larger cities, as London, Liverpool, etc., and owes its origin to immemorial usage in these particular localities, but does not constitute a part of the general common law. In these cities it still subsists in its ancient form, but a process of a similar nature has been established to operate uniformly throughout the realm, which is known as garnishment. This statutory proceeding, however, is applicable not only with reference to foreign but also to domestic debtors; and since it gives a right to seize upon their effects and credits only after the recovery of judgment, it is less beneficial than the special system of foreign attachment. In a number of the U. S. a process similar to foreign attachment has been adopted by statute, providing for a levy upon the property of absent, non-resident, and absconding debtors, but its extent of application is not always the same. Garnishment, which is known in some parts of the country as the "trustee process," may commence with the suit, and includes both foreign and domestic attachment, and is the term generally used to designate the case where a debtor's property or credits may be attached in the possession of third persons. The statutes of the respective States must be consulted. See GARNISHMENT. Revised by H. W. ROGERS.

Foreign Corporations: See the Appendix.

Foreign Judgments: the judgments of a foreign tribunal. As no state is under any obligation to enforce laws which are not of its own creation, the effect to be given to foreign judgments must depend entirely upon the comity of nations in their mutual relations with one another. But the general voluntary acceptance among the states of Christendom of the doctrines of international law has also extended to the recognition of the validity of such judgments when rendered by tribunals having jurisdiction of the cause determined, and when the proceedings were characterized by no fatal irregularity or fraud. Due inquiry may be instituted in regard to the authority of the foreign court and the conduct of the suit, in order to ascertain whether any oppression was exerted or injustice done; but if no error appears the decree is sustained. This practice operates as a great preventive of vexatious and protracted litigation, by which defendants might otherwise be persecuted and the courts burdened, while it nevertheless tends to secure the administration of full and exact justice.

In all cases when it is desired to introduce into any court the proof of a foreign judgment in order that it may be inquired into or enforced, it must be proved and authenticated as a matter of fact. This may be done either by an exemplification of a copy of the judgment under the great seal of a state, or by a copy sworn to as correct by a witness who has compared it with the original, or by the certificate of an officer properly authorized by law to give a copy; which certificate must itself be properly authenticated. When the tribunal rendering the judgment is one whose acts are recognized by the law of nations, such as a court of admiralty, etc., an exemplification under the seal of the court will be sufficient.

The several States of the U. S. are, as regards the proceedings of the State tribunals, regarded as foreign to one another, and judgments rendered in each are accordingly, on general principles of law, sustainable in the others as foreign judgments. But as these States are subordinate to one general government, the effect to be given in one to the judicial acts of another has not been left to depend simply upon interstate comity. In the U. S. Constitution is contained a provision that "full faith and credit shall be given in each State to the public acts, records, and judicial proceedings of every other State, and that Congress may prescribe the manner in which such acts, records, and proceedings shall be proved, and the effect thereof." In pursuance of this authority the following enactment has been passed by Congress, establishing a mode of proof which is, however, not exclusive of any which the State itself may see fit to adopt. "The records and judicial proceedings of the courts of any State shall be proved or admitted in any other court within the U. S. by the attestation of the clerk and the seal of the court annexed, if there be a seal, together with the certificate of the judge, chief justice, or presiding magistrate, as the case may be, that the said attestation is in due form. And the said records and judicial proceedings, authenticated as aforesaid, shall have such faith and credit given to them in every court within the U. S., as they have by law or usage in the courts of the State from whence such records are or shall be taken." If a judgment, therefore, would be conclusive in the State in which it was rendered, it is conclusive in every other State. It is not, however, put upon the same footing in all respects as a domestic judgment. No execution can issue upon it without a new suit in the courts of the State where it is sought to be enforced. It is moreover established that the above statute does not prevent an investigation into the jurisdiction of the court in which the judgment was rendered, or an inquiry as to the point whether it was obtained by fraud.

Some special remarks should be made as to judgments affecting the status of a person or thing, commonly called judgment *in rem*. An illustration of such a judgment as to a thing is a proceeding in a prize court to ascertain the title to a ship; of such a judgment as to a person, a divorce from the marriage contract. The peculiarity of such a judgment is that of its own force it establishes the fact which it announces. A judgment in a prize court that a ship is a U. S. ship makes it a U. S. ship everywhere, even though the court may have proceeded on an erroneous principle of law. In this respect such a judgment differs widely from one between persons (*in personam*), as that requires an act of the executive power to carry it into effect.

As to the effect of a decree of divorce, there is a diversity of opinion. The English courts hold that no foreign court can dissolve an English marriage in such a sense that its decree will be recognized in England. In the U. S. a divorce granted in any State between parties who are domiciled there will be recognized in every other State, if the court had jurisdiction over the parties and there is no fraud. The same rule prevails if the plaintiff be domiciled in a State, and the other party makes due appearance either in person or by attorney to defend the action. For this purpose it is held that a married woman may acquire a different domicile from that of her husband. But if a person residing in one State goes into another and obtains a divorce without the presence of the other party, the decree will not in general be respected in the State of the latter's domicile, because the court has no jurisdiction over the absent defendant. See DIVORCE, MARRIED WOMEN, etc.

Foreknowledge: in theology, God's absolute knowledge or OMNISCIENCE (*q. v.*) from eternity—his knowledge conceived of, as in advance of, before, the thing known. All human knowledge is, strictly speaking, simultaneous with the object it contemplates, or, in a looser sense, may be subsequent to it. In the doctrine of PREDESTINATION (*q. v.*) foreknowledge is regarded in its relation to the salvation of men. It is admitted by all thorough theologians that the foreknowledge of God is *dialectically* distinct from his foreordination or eternal purpose, but as to the question whether or how an absolute (that is, an infallible) foreknowledge (which is conceded by both sides) can be consistent with a conditional foreordination, they answer differently. It is also admitted on both sides that there is no interval of time between the foreknowledge and the foreordination of God; both are alike eternal. The question is, which is properly put first in the system, in the order of nature and of logic? Out of the different answers to these questions have arisen, in large part, the conflicts between ARMINIANISM (*q. v.*) and CALVINISM (*q. v.*). The Calvinists make foreknowledge subsequent to and dependent on foreordination; the Arminians invert the relation, and make the purpose or ordination of God dependent upon what he foreknows. In one system the two are distinct, but not separable; in the other they are separable as well as distinct.

Forel, FRANÇOIS A.: See the Appendix.

Foreland, North and **South**: two promontories of England, on the east coast of Kent, 16 miles apart. They consist of chalk-cliffs 200 feet high, on which are lighthouses to warn the ships from the Downs and Goodwin Sands, which extend along the coast between them. Lat. of North Foreland, 51° 22′ N., lon. 1° 27′ E.; lat. of South Foreland, 51° 8′ N., lon. 1° 22′ E.

Forensic Medicine: See JURISPRUDENCE, MEDICAL.

Foreordination: ordination or decree in advance, the eternal appointment of all ends, and of all men to those ends, by God. When predestination, as some of the Fathers and some of the Calvinistic divines have used the term, covers all the acts of God's will, it is synonymous with foreordination. When predestination is confined to the purpose of God in regard to salvation, foreordination is related to predestination as a whole to a part. See FOREKNOWLEDGE.

Forerius, fō-ree′ri-ŭs, or **Foreiro**, fō-rā′i-rō, FRANCISCUS: b. of noble stock at Lisbon in 1523; entered the Dominican order 1539; studied at Paris, and acquired a brilliant reputation as a linguist, theologian, preacher, and writer; became instructor of the Prince Antonio and preacher to the King of Portugal; was prominent in the Council of Trent 1561–64; was one of the committee which revised the missal and breviary and prepared the Tridentine catechism; became confessor to Cardinal Borromeo; and in 1588 provincial of the Dominicans of Portugal. His chief work is a translation into Latin of Isaiah, with a commentary (1563). D. at Almeida, Jan. 10, 1587.

Foreshortening: in drawing, painting, and engraving, the representation of objects as if turned endwise or partly endwise to the spectator, the whole length being expressed or represented by means of the drawing.

Forestalling: a common-law offense which consisted in buying or contracting for any merchandise or victuals on their way to market with the intent to sell them again at an increased price, or in dissuading persons from bringing their goods or provisions to market, or in persuading them to enhance the price when there. Any device, practice, or conspiracy to enhance the market price of merchandise is a forestalling of the market. The law against forestalling was repealed in 1773, but it retained its penal character at common law till 1844, when it was abrogated by statute 7 and 8 Vict., c. 24. In the U. S. forestalling the market usually takes the form of "trusts" or "corners," being an attempt to enhance the price by monopolizing an article of trade or by regulating the supply. Whether such agreements are criminal or not in the U. S., they are clearly illegal, and an agreement in pursuance of such an object is certainly void. HENRY WADE ROGERS.

Forest Fly: a name given to those insects of the family *Hippoboscidæ*, order *Diptera*, which have well-developed wings. This family includes many of the ticks. All are parasitic. The larvæ are hatched in the oviduct, and turn to pupæ just before birth. The *Hippobosca equina* is a European horse-fly.

Forest Grove: town; Washington co., Or. (for location of county, see map of Oregon, ref. 1–B); on the Southern Pacific Railway; 24 miles W. of Portland. It is the seat of Pacific University and Tualatin Academy (Congregational), and has a canning-factory and grain elevators. Pop. (1880) 547; (1890) 668; (1900) 1,096.

Fores′ti, ELEUTARIO FELICE, LL. D.: patriot and scholar; b. at Conselice, near Ferrara, Italy, about 1793; graduated at the University of Bologna; practiced law at Ferrara; was prætor of Crespino in 1816; was arrested Jan. 7, 1819, as one of the Carbonari, and imprisoned at Spielberg until Aug., 1836, when he was permitted to go to the U. S. Was Professor of Italian in Columbia College, New York, and a teacher for more than twenty years. He was appointed in 1858 as U. S. consul at Genoa, and died in that city Sept. 14 of that year. Published *Chrestomazia Italiana* (1846), and edited an edition of Ollendorff's Italian grammar (New York, 1846).

Forest Laws: laws preventing injury to the soil or trees of a forest or to the game sheltered within its limits. A forest, under the ancient English law, was a tract of woody country in which the sovereign enjoyed an exclusive right to hunt game. Forests were not necessarily inclosed, but they were under the special protection of certain courts termed "forest courts," and a particular system of laws was established to prevent any violation of the king's rights. Both these courts and laws have now fallen into complete desuetude.

Foreston, Ill.: See FORRESTON.

Forestry: that branch of arboriculture which concerns itself with the growing and management of trees in masses, called forests. It is the art of systematically utilizing, reproducing, and improving in productive efficiency natural forests, or of establishing and managing new forests, wherever it is in the interest of man to do so. Forestry stands in the same relation to wood crops as agriculture to field crops, and involves the application of thought and knowledge to attain certain results and accomplish certain ends. The forest is not a mere collection of individual trees, but represents a complete organism with special conditions of existence, special properties, special relationships and functions as a whole. Hence forestry does not deal, except incidentally, with single trees like orcharding, or groups of trees like landscape gardening; it deals with masses. Forestry as a science studies the phenomena of the vegetation in the natural forest; forestry as an art applies itself to utilizing this vegetation without impairing or destroying its physiological functions and its continuance.

Objects.—The objects of the forest in the economy of man are twofold, and forestry keeps both in view. Its first object is to furnish by its wood and other products useful and indispensable materials without which human development and civilization would have been greatly impeded, if not impossible. The readiness with which wood was to be obtained from the natural forests, the ease with which it could be shaped, its adaptation to so many varied uses, its special properties combining strength and elasticity in endless variety, according to the species of tree, lastly the facility with which it can be reproduced, have given it and will always insure for it a most important place among the raw materials at command of man. It is pertinent for the intelligent forester—that is, he who proposes to apply art in the production of this material—to know the qualities as well as the uses of his crop, for his ultimate object is not to grow trees, but to produce material of given quality and fit for given uses. The wide range of application of which wood is capable can only be indicated in this article. While almost any kind of wood will serve for fuel, for charcoal in iron-smelting quality begins to demand consideration. The building of houses, railroads, bridges, trestles, ships, and boats calls for special qualities. Housefinishing and decorative woodwork depend on others; other qualities, again, are needed for carriage-building, tool-handles, and millwork; others for veneering, carving, turnery, bent work, small woodenware and furniture, and the greatest nicety of selection is required for musical instruments. Wood fit for shingle, basket, and box making may not be fit for cooperage. Not only do such minor manufactures as matches, toothpicks, skewers, shoe-pegs, pencils, excelsior, etc., require consideration of the quality of the material, but even for the making of paper pulp not all kinds of trees may be used. Besides the wood itself a number of extractive materials are derived from the forest, the use of which influences the practices of the forester. The bark and wood of some trees, like oaks, chestnut, hemlock, acacias, yield valuable tanning material; others furnish naval stores, as rosin, tar, and, by distillation, turpentine, creosote, wood-alcohol, gas, vanillin, wintergreen, birch oil, etc. Again, wood-ashes act as a valuable fertilizer; brushwood has been successfully prepared for cattle feed; textile fabrics, dyes, ink, edible fruits, birch wine, maple sugar, etc., are yielded by the forest—so that one must readily admit that the richest of natural resources of man, capable of supplying all his wants, is stored in the forest wealth, which therefore calls for especial attention on his part.

The second object of the forest is to furnish a certain condition of soil cover for the influence which such cover has upon climate (see CLIMATE) and upon water conditions. This object has been only vaguely felt, until in more recent times experimental proof has been brought of the relations of forests to meteorological phenomena and to waterflow.

That these influences must be in the first place of limited extent and of a local nature stands to reason, but by accumulation of many smaller local effects of properly disposed forest-areas it is conceivable that the character of climate and waterflow over a larger section of country would be influenced. The relative position of the forest, its extent and its density, besides its composition and height, are important factors in determining its influences on the surroundings. It is therefore improper to speak of them in general; they can only be discussed with reference to the factors named. The forest influence upon soil and water conditions is more or less important, according to the topography and geologic formations. It consists in holding the soil upon steep slopes, preventing erosion in hill lands underlaid with impenetrable subsoils, the formation of shifting sands checking the rapid, superficial flow of waters and the formation of destructive torrents with the consequent sanding over of fertile valley lands, the filling up of rivers with *débris*, and the increased danger of floods. The forest cover excluding sun and wind checks evaporation, and thereby renders more water available in the soil, the crowns, underbrush, moss-cover, and litter or forest floor prevent the mechanical action of the rain-drops in compacting the soil, facilitating thereby percolation and the formation and constant flow of springs, except where geologic formations (limestones without cleavage, etc.) prevent or impede such subterranean drainage. Altogether, the action of the well-kept forest in this direction is to regulate and equalize the run-off, serving as a storage basin to prevent or at least reduce excessive floods and droughts. For proof of these influences not only the desolation of once fertile regions of Mediterranean countries, but especially the experience of modern France, may be cited, where also, by reforestation of denuded and eroded mountain-slopes, a correction of the unstable soil and water conditions has been effected. The effect of a timber belt as windbreak, in reducing the velocity and thereby the evaporative power of the wind for some distance beyond, is well established, and of importance to the growing of crops in wind-swept prairies. The forest influence upon meteorological conditions, temperature, humidity, and rainfall is a mass effect; i. e. it is dependent upon the amount of soil area shaded and upon the density of the shade by which a difference of temperature (lowering) and of humidity (increasing) of the air within and above the forest is effected as against the air over the open field. To become effective there must be air columns of considerable amount affected to an appreciable degree, and since the differences of conditions can be communicated to the open field only by air currents, the location of the forest toward the prevailing currents is also of moment in exercising an influence.

Forest Policy.—Both of the objects which the forest is to serve must enter into the consideration of the forester as well as of the nation at large, and must influence the policy which legislators and administrators of public interests should pursue with reference to the forest cover. Every civilized nation, and even some of the nations which are wont to be considered lower in the scale of civilization, like the Japanese and Korean, have sooner or later recognized that besides the private interest in forest property there exists a far-reaching, more or less direct or indirect public interest in the existence and condition of the forest cover, which necessitates special governmental consideration and policy. The guiding principles of such a policy should be (1) that as far as production of material is concerned the widest latitude should be left to private enterprise, only aiding such enterprise by furnishing correct statistical information regarding supply and demand, and furnishing educational facilities; (2) that adequate protection by law be extended to forest property, and such ready means of enforcing the law be provided as the difficulty of protecting it against damage requires; (3) that wherever damage would result to neighboring property by improper methods of management the state shall interfere in behalf of the threatened adjoiners; (4) that where reforestation of denuded areas is desirable for public reasons the state should either aid private or communal enterprise, or else undertake reforestation as a work of internal improvement; (5) that where permanency of forest cover for climatic or hydrologic reasons is necessary, and private interest, either for a lack of profitableness or otherwise, can not be expected to engage in a conservative management of the same, the state should own and manage the forest.

In addition, since forest growth can be supported on the poorer soils, the relegation of the forest to these, giving up the richer portions to agricultural use, is a proper economic policy, while to produce upon the smallest area by means of wood crops the largest returns is the financial policy of the forester.

Forestry Technique.—Forestry as an individual pursuit, like all such pursuits, is based upon technical as well as economic considerations, and consequently there are two distinct or separate directions in which forest management must develop, namely, forest production or sylviculture, and forest economy or forest organization. Sylviculture concerns itself with the technical manipulations by which the greatest quantity and best quality of crop are produced, while forest economy provides for the systematic organization or running of the business of forest production and for its best financial results, acting as the economic regulator of the productive technique.

There is greater need for such a systematic *organization* in forest management than in other pursuits, because a long time elapses between the sowing and the reaping, and because, since the crop may be utilized at various stages of development, it becomes a matter of considerable study when it is most profitable to take it. In a comprehensive forest management, it is also difficult to determine how much is to be left as working capital or stock, and how much of the growth is to be considered as interest or accumulated accretion to be harvested. If, furthermore, it is desired to make the revenue as nearly as possible equal, or to harvest equal amounts of material from year to year, a further complication arises. In Europe this side of the science has been very thoroughly elaborated, a considerable amount of mathematics being applied in this elaboration. The matter can be dismissed here with a simple enumeration of some of the problems that require solution in the four subdivisions in which this part of the science is generally presented; namely: (1) forest surveying; (2) forest valuation; (3) forest regulation; (4) forest administration.

In order to secure a systematic and regular procedure in the management of a forest property, it is above all things necessary to find out what its annual yield is or can be made, its normal sustained increment, its capability. This depends of course, in the first place, upon the soil and climatic conditions, next upon the kinds of trees composing the forest, and finally upon the condition of the forest and its management. These matters being ascertained by a forest survey, forest regulation then proceeds, depending upon a thorough knowledge of the laws of accretion or annual growth, involving a study, not only of the mass and form development of the single tree under varying conditions, but also that of the forest growth as a whole, its mass increment, and the distribution of the same through various ages. Besides the mass accretion, there is also to be determined a quality increment, and dependent upon both a value increment. It then is possible to determine how much wood may be harvested from time to time, and how much must be left as normal stock, upon which the normal increment can take place. It is then also determined with what rotation the forest is to be cut, i. e. how long a time may elapse until a full crop can be most profitably cut, also the system of sylviculture, whether coppice or timber forest is more advantageous. As further basis for such regulation, it is desirable to determine by the methods of forest valuation the money value of the property, in order to ascertain whether the capital represented in the soil and in the growth does yield or promise to yield a satisfactory interest, and what kind of management might be most advantageous. Closely connected with these financial problems is the consideration of expenditures for administration. All these problems, to be sure, are of greater importance in a large and complicated forest economy, such as the various government administrations represent, and become of less and less importance, and are less complicated as the area of the forest to be placed under systematic management decreases.

In a well-conducted forest administration the forest is divided not only into districts, sub-districts, ranges, etc., which serve as units of organization each under a competent manager, but each of these divisions is divided again into blocks, compartments, groups, and age-classes, which serve as units of management. The management is carried on upon a carefully prepared working plan, revised from time to time, which indicates for years to come, perhaps a century and more, the operations to be performed in each compartment or group, the annual or periodical cut, which is kept as nearly equal as possible in area or mass, and the methods of regeneration, etc.

Under the name of *sylviculture* may be comprised all the manipulations in the field which have for their object the best development of the crop, and which may readily be considered in three divisions, namely: those concerned with the improvement and cultivation of the crop; those insuring properties against fire, insects, and other damage; and, lastly, those which have reference to a well-regulated method of harvesting or exploitation, such method determining in part the system of reproduction or regeneration. Artificial forestation or forest-planting is practiced either where the original forest has been cut away without regard to natural reproduction or where there was no forest, as in the treeless plains.

The considerations which require attention in forest-planting are the selection of plant material adapted to soil and climate, and with reference to the value of the product; the manner of disposing it on the ground: the method of planting it. All operations must be considered from the sylvicultural standpoint as well as with regard to the financial result. Whether, therefore, to sow the seed or to plant seedlings grown in a nursery, whether to plow and thoroughly prepare the ground or only to open trenches in which to plant, or to use the dibble, as well as the selection of plant material, are questions both of sylviculture and finance which can only be discussed with reference to given local conditions and special cases. Only the leading principles in forest-planting may be stated here. Mixed growths are preferable to those of single species (by themselves), because they may be made to yield larger returns, and offer better soil protection and greater resistance to damage by winds, fire, and insects. In the selection of species for mixed planting, besides their adaptability to soil and climate—those native in a region deserve first consideration—and the value and rapid development of their product, their behavior to each other, and their relative development must be considered, which are predicated by their relative dependence for development on light and shade, their relative rate of height growth, and their relative capacity for preserving and increasing favorable forest conditions. Out of these considerations the following rules to be observed in mixed planting arise:

1. The main growth—i. e. the one that occupies the larger part of the ground—must be of a kind that improves soil conditions, namely, a densely foliaged, shade-enduring kind, which does not lose its shading capacity with age. 2. Densely foliaged kinds may be grouped together, if the slow grower will endure the shade of the rapid grower, or can be protected against its supremacy by being planted in larger specimens, or in advance of the former, or in larger numbers, or if its gradual killing out after it has served its function of soil cover is not objected to. 3. Thinly foliaged kinds should never be grouped together where soil humidity is to be preserved, unless no shady tree can be found to fit the locality. 4. In grouping light-needing with shade-enduring kinds, the former must be more rapid growers, or must otherwise be given an advantage. A mixture of deciduous trees with conifers, where the latter are otherwise adapted to soil and climate, gives ideal conditions, the conifers furnishing more continuous cover, developing best with the deciduous trees as neighbors, and yielding most valuable material. Since the first object to be attained is to create as quickly as possible a soil cover, dense planting is the rule, 6,000 to 8,000 plants per acre, and even 10,000 where, as in the prairie, evaporation is rapid and the need of a soil cover greater. This dense planting obviates after-cultivation. For nursery practice and general practice in handling plant material, see NURSERY, and the various plants under their respective heads.

While it is mostly cheaper to sow the seed in the first place where it is to grow, sowings are apt to come up unevenly, require more aftercare, and the loss in time and development often makes planting of seedlings more profitable in the end. Young, well-rooted seedlings, two to three years old, are preferable to older plants, because cheaper and more successfully handled. Cuttings of various kinds, like cottonwoods and willows, can also be utilized, but this kind of plant material is not advisable where long-lived timber trees are wanted. Only sufficient preparation of the soil to give the plants a successful start the first year is needed, since it is impossible to keep up cultivation, and the labor expended at the first soon loses its effects. In sandy soils planting with dibbles of various shapes is practiced in Germany, one man setting 1,200 plants in a day. Various methods of planting, adapted to different soil conditions, are practiced in Europe—bunch-planting (several plants in one hole), top or mound planting (setting plants on top of ground in wet localities), sod-planting (taking up and setting plants with ball of earth), notching with hatchet or spade, furrow-planting, etc. Various planting-tools are also in use. An ingenious mechanical planter, which prepares the soil and plants the seedlings in trenches in one motion at the rate of 20,000 per day, has been patented in the U. S. On the prairies thorough cultivation and sometimes several years' cropping of the soil before planting has been practiced, with cultivation between the widely set rows of trees afterward. It is questionable whether this is necessary or even desirable. Cultivation may be avoided by dense planting. To establish forest conditions must be the first aim of the forest-planter.

Forest conditions, as found in the natural forest, consist in dense growth, mixed growth, undergrowth. By so much as any one of these conditions is deficient or lacking, by so much is the forest short of the ideal. Reduced evaporation is forest condition. Shade reduces evaporation. Dense growth furnishes not only straight clear timber, but shade. Mixed growth alone can preserve a continuous shade for a long time. Undergrowth assists in keeping the ground shaded.

Natural regeneration or reproduction is practiced where natural growth of desirable kinds exists, either by a new growth of sprouts or shoots from the stump or stool or from the seeds sown by the old trees. The former method, reproduction by shoots, is called the *coppice* system (German *Niederwald*; Fr. *taillis*). It is applicable only to such kinds as have the capacity of readily sprouting; the conifers are therefore excepted. Some broad-leaved trees also do not sprout readily enough to admit of their management in the coppice system. Shoots, while growing more rapidly than seedlings at first, relax sooner and remain comparatively short. This system, therefore, is fit for the production of firewood, ties, posts, hoop-poles, and wood of small dimensions only; also for tan-bark purposes or for mere soil cover. The coppice should not be allowed to grow longer than thirty or at the longest forty years, since with longer rotation the stocks or stools lose their reproductive power too soon; deep rich soil and a mild climate are most favorable to the maintenance of reproductive power. Cutting is best done in spring before buds start, should never be done during heavy frost; the cut should be smooth and as low as possible in order to reduce liability to injuries and induce formation of new independent roots from the shoots. If, when cutting the coppice at the age of from ten to twenty years, some trees are left to grow to larger size—standards—thus combining the coppice with the timber forest, a system results which the Germans call *Mittelwald* (Fr. *taillis sous futaie*), and which may be translated *standard coppice*, a system which offers many advantages where inferior firewood can be disposed of, and especially for smaller forest areas where more special attention can be given to the treatment of the standards, to avoid their unwelcome branching. The coppice growth must be made up of deciduous, shade-enduring kinds with considerable reproductive power; the standards should be of less shady kinds, that produce desirable material. The coppice is cut several times before the standards are ready for use. The *timber forest* or seedling forest (German *Hochwald*; Fr. *futaie*), in which it is proposed to grow trees to full maturity for lumber, is reproduced entirely by seed from mother trees, or planting after the old growth has been cut. The latter method, which appears the simplest, had become of very general practice in Europe, in many cases with rather unsatisfactory results in the end, through desiccation of the soil and enormous increase of insect pests on large sun-warmed clearings. Hence a return to the natural regeneration systems from seed trees has begun, so that the following statement can be given as a guiding rule:

Forestry in a wooded country means harvesting the wood crop in such a manner that the forest will reproduce itself in the same if not in superior composition of kinds. Reproduction, then, is the aim of the forest manager, and the difference between the work of the lumberman and that of the forester consists mainly in this: that the forester cuts his trees with a view of securing valuable reproduction, while the lumberman cuts without this view, or at least without the knowledge as to how this reproduction can be secured and directed at will. The efficient forest manager requires no other tool than the ax and saw—the planting tools being needed only to correct his mistakes—but he uses them differently from the lumberman.

There are two systems of natural regeneration by seed possible, namely, the system of echelons (German *Randbesamung*, *Coulissenschlag*; Fr. *coupe par bandes alternes*), in which strips are cleared and a neighboring growth of seed trees left to supply the seed for reproduction, and the system of regeneration under nurses or shelter-woods, leaving a certain number of seed trees scattered over the area on which the timber is to be regenerated, gradually removing them as the young growth requires more light. This is the manner in which the primeval forest regenerates itself if left alone, old trees falling and young growths starting in the breach. Man merely brings method into this process of regeneration. In the latter system various methods are practiced, which are distinguished as the "method of selection" (German *Fehmelbetrieb*, *Planterwald*; Fr. *jardinage*), or the "group method" (German *Loecherhieb*), when the mature trees over the entire forest area are taken out irregularly in single individuals or groups, the gradual regeneration also taking place irregularly and in small patches, when the forest contains always trees of all ages; and the "compartment method" (German *Fehmelschlag*; Fr. *mode des éclaircies*), when the process of regeneration is concentrated upon a given portion of the forest area, a compartment, so that in a few years the old growth is replaced altogether by an even-aged young crop. In both these methods the consideration of the relative need of light or shade by the different species at different stages of development is the guiding principle in the manipulations, so that forest management may be said to be a management of light conditions. It is also necessary to keep in mind that most or many of our most valuable trees do not bear seed every year, at least not plentifully, and hence the cutting must be done with reference to the seed years.

The method of echelons is applicable for species with light or winged seeds, which the winds can easily scatter over the clearing, and for light-needing species, which can dispense with the protection that the mother trees give to the young growth. The method of compartment regeneration is used with species which either can endure or require in their early stages of development the cover of the mother trees. Three stages, occupying longer or shorter time according to soil, climate, species, and other conditions, appear in this manipulation of cutting for reproduction, and together are called the regeneration period.

First, "preparatory cuttings" occupy several years before the expected seed year. These consist in taking out undesirable species which are not to be reproduced, and thinning the mother trees to an even stand, allowing light and air to penetrate to the soil sufficiently to fully decompose the raw humus and form a good seed bed.

When the seed year appears, an even crown cover must have been secured, having left about 0·4 of the normal number of trees per acre evenly distributed over the area to be regenerated. A failure of the seed crop sometimes requires waiting for another seed year. When the seedlings have appeared the third stage begins, that of "cutting for light," with a gradual removal of the mother trees, as the seedlings require more light, the whole period of regeneration occupying from five to ten or even twenty years. Various modifications of this as well as of the next method are practiced. Where the natural sowing fails, the fail-places must be planted by hand. The group method differs only in the smaller extent of the area brought under regeneration. The method of selection is the most natural and most conservative, as well as the oldest; almost entirely abandoned for a time on account of its many drawbacks, it has recently come again into more general practice. It is the method which the lumberman unconsciously practices as he culls out the desirable material, only that he fails to consider the needs of the aftergrowth. Requiring considerable individual attention in all parts of the forest, it is perhaps more applicable to smaller areas, while the more schematic compartment method deserves first place in forests of greater extent.

Besides these typical methods there are in use more or less developed modifications and combination methods, such as the so-called double rotation timber forest, where a greater or smaller number of trees are held over for a second rotation to make large-sized timber; the method of "undergrowing for light accretion" (*Lichtungsbetrieb mit Unterbau*) to secure heavier dimensions where the forest of forty or sixty years of age is severely thinned, and to maintain favorable soil conditions an undergrowth of shady kinds is established underneath the older timber; the combination of coppice with agricultural crops, known as *Hackwald* in Germany, and practiced largely in France under the name of *sartage*, when the soil is given up to field crops for a few years after cutting.

Improvement Cuttings, and Thinnings.—After the young growth is established it becomes desirable to aid its most advantageous development. This is done by a judicious thinning out, so as to preserve a proper density of the crop, two principles being the guides, namely, not to expose the soil to sun and wind too much at any time, and to give sufficient light for rapid and vigorous development of the trees without permitting the formation of undesirable low branching. Prevention of the latter is preferable to cure by pruning. This is rather expensive, and the results are not always satisfactory. The first thinning may be done when the trees are fit for hoop-poles, removing the less desirable growth; afterward the golden rule is to return often and not to thin too severely.

Forest protection is especially needed against fire and insects. Running fires destroy the vegetable mould and underbrush; top fires lay low the trees. To reduce this danger not only great care in the use of fire is required, but in order to confine and control any that has started the forest, especially in the pineries, is divided into blocks and compartments by cleared rides or roads regularly laid out and crossing each other, kept clear of underbrush, proceeding from which the fire may be fought. Running fires are beaten out with brush, checked by ditching or by counter-fires; top fires are stopped by felling strips of timber, and thus preventing further spreading.

Caterpillars destroy the foliage of healthy trees, the larvæ of beetles destroy the wood and the buds of young trees, and injure the roots of young growths. Many methods of defense are practiced, the annual outlay for which by the Prussian Government forests averages $60,000 per year. Prevention again is better than cure. It consists in growing mixed forests, and keeping them as shady as possible.

Exploitation consists in the proper felling and most economical adaptation of the various woods and dimensions to their most profitable use, providing means of transportation, etc. A good road system well laid out and well kept, supplemented by other means of transportation, is the keynote of profitable forestry, for only where all material can be readily marketed does the cost of production and the desired interest on the capital result. The harvesting of by-products, which sometimes, as in the case of tan-bark in the tan-oak coppice, becomes the main product, also requires special attention.

History and Statistics.—The history of the forest has been the same in all parts of the world, progressing according to the cultural development of the people. First it was valued as the harbor of game; then it appeared as an impediment to agricultural development, and relentless war was waged against it; then the value of its stores made it an object of greedy exploitation, and only in a highly civilized nation does the idea of the relation of forests to the present and future welfare of the community lead to a rational treatment of the forest cover and the application of the principles embodied in the science of forestry. Modern forestry, such as is more or less practiced now by all European people, is of modern and mainly Teutonic origin. There existed some knowledge as to the nature of forest growth and the advantages of its systematic use among the *Romans* and *Greeks*. The consecration of forests to the gods may be considered as a means to prevent their devastation. Ancus Martius, the fourth King of Rome (about 64 B. C.), claimed the forests as a public domain, and placed them under special officers; later, under the republic, they were in special charge of the consuls. Subsequent wars, however, seem to have wiped out not only the administrative features, but most of the forests themselves.

To *Germany* in the first and France in the second place belongs the palm for the beginning as well as for the scientific development of rational forestry systems. The first attempts in this direction seem to antedate even Charlemagne's time. At the end of the eighth century the "ban forests" (*foresta*) had been established—i. e. woods in which the king had the right reserved to exercise the chase. (Afforesting and disafforesting are terms having reference to the establishment and discontinuance of such forests.) After a time favored vassals, ecclesiastics, and others had such rights reserved for them, and gradually the "forest" included not only woods but fields and other open territory, and under the plea of guarding the chase regulations in the use of the wood were enforced. But long before this those communistic villagers, aggregated in the "Mark," had themselves regulated the methods of using the communal forest. These regulations, originating among a crude people six or seven centuries ago, were indeed wise and rational when compared with the irrational methods pursued at the present time in the U. S. The amount of wood to be harvested was determined beforehand, the better kind of timber being more economically cut. For firewood the dry and inferior timber was assigned. Charring, boxing for resin, etc., were carried on under precautions. The number of swine to be allowed in the oak or beech forests was determined according to the mast. The damage by sheep and goats was recognized, and their pasturing in the woods prohibited as early as 1158. Even an arbor day was anticipated in some parts, each man having to plant under supervision of the appointed forester a number of trees proportionate to his consumption; in 1368 the city of Nuremberg began reforestation on a larger scale with conifers, which was imitated by other communities; and in 1491 a regular artificial reforestation by annual sowings of oak was undertaken by the community of Seligenstadt. The end of the fifteenth century also witnessed quite a systematic regulation of the annual cuttings by the communal authorities, the cities and villages having increased their holdings by large forest properties given by or bought from the kings and princes, and also fully organized administrations of the forests belonging to the latter were instituted. The law punished with heavy penalties trespasses of all kinds. The Thirty Years' war, which extirpated many of the villages and cities, and other causes increased the holdings of the princes and nobility, and gradually the communal forest was to a large extent supplanted by the royal and lordly forest, or (by partition) by private forest of the farmers. These, however, remained encumbered with servitudes—i. e. right of adjoiners to certain use of the forest and its products—for which use counterservice was demanded, such as aid in extinguishing fires, dropping and hauling of wood, or other assistance in forest culture. Fires devastated large areas in the seventeenth and eighteenth centuries, and a period of neglect and bad management reduced the forest area to poor conditions, upon which the many regulations and orders of the princes against devastation had little effect. Under these circumstances the development of the technical part of forestry was naturally slow. Yet many methods of forestry practice still existing in modified forms date from the beginning of the eighteenth century, while in the latter part of the same century the foundation for the present system of management and policy was laid, and forestry science in all directions built up with remarkable activity, becoming one of the branches taught at several universities, besides a number of special forestry schools. Yet the forest conditions in the beginning of the nineteenth century were deplorable, and the same reformatory movement now beginning in the U. S. was necessary to bring about the improvement of modern times. Among the most active writers of that time and as fathers of modern forestry may be named G. L. Hartig, whose treatise on sylviculture, the first forestry book on a scientific basis, is still authority in many directions, H. von Cotta, F. W. L. Pfeil, Hundeshagen, König, and Carl Heyer.

At the beginning of the nineteenth century forest property comprised three classes: first, the forests, formerly princely, which have become state property; second, those remaining the private property of royalty, private individuals, or institutions; and, third, the communal forests, belonging to cities, towns, villages, or merely associations. The first, representing about 35 per cent. of the total forest area, are entirely under the jurisdiction and management of the state, with special forest departments; the communal forests (about 15 per cent. of the forest area) are under more or less strict supervision of the state authorities, with a view to preventing devastation; but the private forests, containing nearly 50 per cent. of the total forest area, are almost entirely without such supervision, yet from prudential reasons are generally managed systematically according to conservative principles. Lately, however, the fuller recognition of the protective character of forest cover has created the tendency to restrict private owners from such use of their property as may endanger adjoining interests, and at the present writing (1893) a law is under discussion to further extend such restrictions.

With well-established forest administration of Government forests, with forestry schools or chairs of forestry at universities, and twenty periodicals devoted to forestry alone, Germany is the exponent of the most advanced ideas in this branch of economic science and art.

The policy of the Government is to increase its forest area by the acquisition and replanting of waste lands, and turning over to agricultural use such tracts of forest land as are profitably so employed, so that finally the land occupied by forest growth shall in the main represent such as is not useful except for timber crops. In this direction there were spent during 1883–93 over $3,000,000, increasing the holding of the state by over 200,000 acres, besides exchanging some 30,000 acres. During the same time the Government spent in subventions to private enterprises in reclaiming waste lands the sum of about $30,000 per annum.

The following figures, from official sources of the Prussian forest administration for the year 1890, will serve to give an idea of the financial results of a well-ordered forestry system:

TABLE SHOWING FINANCIAL RESULTS OF PRUSSIAN FOREST ADMINISTRATION, 1890.

Area: 6,685,768 acres, including 687,982 acres not woodland.

Expenditures for the year.

Administration:		
Direction, 122 officers	$154,350	
District managers, 681	588,276	
Under-foresters, 3,753	1,162,867	
Financial agents, 114	73,141	
Rangers, temporary	12,332	
Other *personnel* expenses	1,061,255	
		$3,052,221
Or 46 cents per acre.		
Management:		
Harvesting	$2,266,030	
Building account	599,834	
Roads and waterways	410,102	
Planting and cultures	1,230,882	
Surveys	110,226	
Protection against insects	60,454	
Sundries	280,973	
		$4,958,501
Or 74 cents per acre.		
Various:		
Forestry schools and experiments	$48,131	
Purchase of waste lands	304,156	
Sundries	434,682	
		$786,969
Or 12 cents per acre.		
Total expenditure		$8,797,691
Or $1.32 per acre.		

Revenues for the year.

Wood:	
962,300,000 feet B. M. saw-timber at $10.32 average.	$9,931,000
2,074,830 cords of wood at $3.70 average	6,224,497
17,930 cords tan-bark at $3	66,341
	$16,222,738
By-products	1,036,773
Game	84,056
Sundries	289,243
Total	$17,632,810
Or $2.63 per acre.	
Net revenue	$8,835,119
Or $1.31 per acre.	

Saw-timber represents 45·6 per cent. of total wood product, and 61·6 per cent. of total money yield, the total wood production (annual accretion) being round 280,000,000 cubic feet, or about 46 cubic feet per acre of woodland, worth 5·8 cents per cubic foot.

In *France*, in early times, the same communal conditions and usages existed as in Germany, and the progress in the development of forestry is similar. After various ordinances issued by the kings from time to time, regulating the use of forests, among which, that of Philip August in 1219, a definite "administration of forests and waters" was instituted in 1346 by Philip VI., and a tribunal for forestry cases established in the *Table de Marbre*, which was much abused for extortions, especially under Henry II. Under Charles IX. control over private forest property was considerably extended. Henry IV. (1589) strove in vain to bring order into the management; forest devastation remained the rule until the famous ordinance of Colbert in 1669, under which France was divided into forest districts, and with a reorganization of the administration in a severe manner the cutting on private as well as public forest lands was regulated. This organization lasted until 1790. During the eighteenth century forestry matters were discussed by such well-known scientists as Réaumur, Duhamel, Buffon, who about 1774 first advocated the advantages of thinning. The Revolution opened wide its doors to the destructive element, and the damages which France is now working to repair date largely from those times. Napoleon revived the forest administration in 1801, but the present system came into practice only with the forest code of 1827 as an outcome of Lorentz's studies in Germany. The establishment of a forest school at Nancy in 1824 must also be credited to the exertions of this man. Later laws (1860–82) establish the cases in which the state may interfere with private forest property, and have reference especially to reforestation of mountains.

The territory directly injured by the torrents resulting from forest devastation comprised about 8,000,000 acres of tillable land. Some $10,000,000 have been spent so far to reforest and resod the denuded mountain sides, while nearly $40,000,000 more are estimated necessary to put in proper condition the 800,000 acres needing reforestation.

Austria and *Switzerland* stand next to Germany and France in the development of a well-established forest policy. *Italy* has a forestry school at Vallombrosa, and Government forest administration. An excellent law compelling reforestation of denuded mountain-slopes was passed in 1890. *Spain* and *Greece* have less developed forestry systems. In *England*, although with William the Conqueror the idea of the forest as a territory reserved for the king's chase was imported, forestry proper has received but little attention. There was, however, instituted during the years 1847 to 1864 a forestry service for India, and a forest school in Cooper's Hill, England, in 1885, and lately more activity in forestry matters appears. The forests of the crown are indifferently managed, but private owners, especially in Scotland, apply better methods to their holdings. The British colonies in Australia and lately in Africa have organized forest administrations. *Norway* and *Sweden* have but imperfectly developed forestry practice. In *Russia* a Government forest administration and several schools exist. Even *China*, *Japan*, and *Korea* have developed forestry systems, and at Tokio University forestry is one of the branches taught.

COMPARATIVE AREAS OF FARM, FOREST, AND OTHER LAND IN THE UNITED STATES AND IN EUROPE.

COUNTRIES.	Areas.	Agricultural soil in actual use (in U. S. 300,000,000 acres).	Forest (in U. S. 500,000,000 acres).	Waste or unoccupied, but capable of production (in U. S. 800,000,000 acres).	Roads, water, and land incapable of production.		Agricultural soil per capita.	Forest per capita.
	Acres.	Per cent.	Per cent.	Per cent.	Acres.	Per cent.	Acres.	Acres.
United States	1,750,000,000	17·10	25·00	45·70	160,000,000	9·14	6·00	9·8
Germany	133,421,492	60·76	25·62	9·70	5,235,519	3·92	1·09	0·79
Austria	153,820,044	54·70	31·30	8·00	9,229,311	6·00	2·35	1·33
Switzerland	10,252,099	32·00	18·80	20·00	2,993,490	29·20	1·19	0·69
Italy	63,546,066	65·00	20·00	7·78	4,589,821	7·22	1·48	0·47
France	130,616,662	63·35	17·70	13·50	7,108,713	5·45	2·25	0·62
Belgium	7,278,625	78·43	12·00	3·20	462,837	6·37	1·06	0·17
Netherlands	8,147,710	59·29	5·97	23·23	937,782	11·51	1·25	0·12
Great Britain	77,692,866	60·55	3·23	30·35	4,564,121	5·87	1·38	0·07
Denmark	9,441,825	67·97	4·61	17·27	958,539	10·15	3·35	0·22
Sweden	109,272,783	10·50	*39·50	40·87	9,971,135	9·13	2·59	9·75
Norway	78,258,007	2·70	*30·64	53·68	10,163,387	12·98	1·17	13·19
Russia	1,336,876,607	30·00	38·00	27·42	61,216,807	4·58	5·43	6·89
Turkey	130,336,347	20·00	24·00	37·91	23,569,351	18·09	1·73	2·07
Greece	12,385,894	16·00	11·80	27·50	5,536,252	44·70	1·36	1·01
Spain	125,461,700	44·30	16·30	25·00	18,066,459	14·40	2·32	1·23
Portugal	22,938,974	50·00	5·00	30·00	3,440,759	15·00	2·45	0·25
Europe	2,409,757,701	35·95	31·29	25·79	168,044,190	6·97	2·79	2·45

* The most recent returns reduce the percentage of forest in Sweden and Norway to 24 and 25 per cent. respectively.

The figures given in the above table, so far as they relate to other countries, are taken from European statistical tables, based upon the state of things existing in 1880. No such exact figures can be given for the U. S. In the estimates and approximations, given in round numbers, neither Alaska, the Indian Territory, nor Indian reservations are included, the forest condition of these not having been ascertained. The forest area is taken from an estimate made by the forestry division of the U. S. Department of Agriculture in 1885. For the amount of farm land under cultivation, as well as for unoccupied and waste land, whether capable of profitable use or otherwise, reliance has been placed upon the census returns. The per capita estimates are made upon the basis of population in 1880, viz., 50,000,000.

Reliable statistics for the U. S. are absent, but the situation may be briefly summarized as follows: The estimated area of woodlands comprises in round numbers 500,000,000 acres, or 25 per cent. of the total land area: the annual consumption of wood of all description is in the neighborhood of 22,000,000,000 cubic feet, of which the larger part, over 80 per cent., is firewood; the value of all forest products increased from $500,000,000 in 1860 to over $1,000,000,000 in 1900. The exportations of forest products and manufactures of wood in 1900 amounted to $50,598,416, with importations to the amount of $20,591,908. Forest fires destroy annually thousands of square miles of standing timber, or destroy the forest cover. The U. S. Government retains about 50,000,000 acres of woodlands, mostly situated in the Western mountain-ranges, and without administration, excepting some regulations by the land-office.

Apparently the forest policy of the Government has been to get rid of the land and that of the people to get rid of the timber. The first forest reservations from the public domain, for forest purposes in part, were made in 1891. No administration of these is as yet provided. In the Department of Agriculture, however, there exists a bureau of research and advice without administrative functions called the division of forestry. The only State attempting a management of its public woodlands is New York with a forestry commission exercising control over the Adirondack forest, some 700,000 acres in extent, an area which is to be extended. Forestry commissions exist in various States, but mostly of an advisory character. No real forest management by private owners seems to exist. Rapid, wasteful, and unsystematic exploitation is the rule. Forest-planting on a small scale and with only partial success has been practiced mainly in the treeless plains, the Government until lately encouraging such by the granting of proportionate areas of land, in fee simple, under the so-called Timber Culture Act, now repealed.

Other means of encouraging a more rational use of the forest resources consist in the establishment of arbor days, now celebrated in almost every State, the formation of societies, among which the American and the Pennsylvania Forestry Associations are most active in trying to change the forest policy in the U. S. and to introduce more rational systems. Instruction on forestry matters is being given at various agricultural colleges. B. E. FERNOW.

Forey, fō̆rā', ÉLIE FRÉDÉRIC: general; b. in Paris, France, Jan. 10, 1804. He was educated at the military school of St. Cyr; distinguished himself in Algiers; became general in 1848, and took an active part in the *coup d'état* of Dec. 2, 1851. In the Russian and Italian wars he held important commands. In Aug., 1859, he was made senator, and in July, 1862, was placed in command of 30,000 men destined for the invasion of Mexico. Landing at Vera Cruz, Sept. 27, he issued a conciliatory proclamation, but shortly after ordered the sequestration of goods of those who opposed the French. Puebla surrendered after a severe siege, May 17, 1863, and he occupied Mexico city soon after, forming a provisional government. On July 2 he was made marshal of France. In Oct., 1863, he turned over the command to Bazaine, and after a short diplomatic visit to the U. S. returned to France. D. in Paris, June 20, 1872.

HERBERT H. SMITH.

Forfait, fō̆r'fā', PIERRE ALEXANDRE LAURENT: engineer; b. at Rouen, France, in 1752; studied mathematics and hydrography, in which departments he won several prizes offered by the academy of his native city; and in 1783 obtained an appointment as engineer in the navy by the influence of the Duc de Penthièvre. He distinguished himself before Cadiz and at Brest, published several scientific treatises (*Sur les vers marins, Sur une machine propre à curer et creuser les canaux, rivières et ports, etc.*), and was charged with the construction of large transport-vessels destined to run regularly between France and her colonies. Elected a member of the Legislative Assembly in 1791, he had a seat in the committee on naval affairs and exercised great influence on its proceedings. But he had little sympathy with the Revolution; he was not re-elected, and he was even imprisoned for a short time as suspected. The Directory, however, again employed him, and charged him with the construction of the so-called Seine boat. (See his *Rélations des expériences faites sur la navigation de la Seine* in the *Transactions* of the Institute, 1798.) With Napoleon he was for a long time a great favorite, and he was at the head of the preparations for an invasion of England; but after the Peace of Amiens he resigned his position in the navy, and shortly after he retired into private life. Besides the above-mentioned treatises, he published a great number of papers on military and civil engineering in various scientific periodicals. D. at Rouen, Nov. 8, 1807.

Forfar, Forfarshire, or **Angus**: a maritime county of Scotland; bounded by the German Ocean, the Frith of Tay, Kincardine, Aberdeenshire, and Perthshire. Area, 880 sq. miles. Its surface is very varied, ranges of hills, the Sidlaw and the Oatlaw, alternating with valleys, the Vale of Strathmore, and the plain along the Tay, and its soil is fertile and well-watered by the Tay, the North and South Esk, and the Isla. The climate is mild and favorable to agricultural pursuits. The manufacture of coarse linen is a very important industry in which many thousands find employment. Pop. (1891) 277,788; (1901) 283,729.

Forfar: town; capital of Forfarshire, Scotland; situated in the Vale of Strathmore; 14 miles N. N. E. of Dundee (see map of Scotland, ref. 9–I). It has important manufactures of heavy shoes and coarse linens, and is connected with Aberdeen by the Scottish Midland Junction Railway. It has fine public buildings. Pop. (1891) 12,844.

Forfeiture [from O. Fr. *forfeture, forfaiture* < Low Lat. *forisfactu'ra*, deriv. of *forisfa'cere*, act beyond, transgress; *fo'ris*, out of doors + *fa'cere*, do, act]: a loss of property to the state or an individual as a penalty for the commission of some offense. Forfeiture is either civil or criminal. In civil forfeiture the property passes into the possession of some individual who has been injured by the violation of his rights through some neglect or transgression of duty on the part of the property-owner. There are several classes of cases in which this penalty might be incurred at common law, and in some of them it is still retained. Thus in former times if an owner of a limited interest in real property, as a tenant for life or for years, attempted to convey a larger estate than he himself possessed by making a feoffment in fee simple, not only did the grantee receive nothing, but the grantor's entire interest was forfeited to the reversioner or remainderman. But at the present day this rule has no application, and an excessive grant is operative as a valid transfer of the grantor's actual interest, and of nothing more. In like manner, a tenant might forfeit his estate by disclaiming the title of him under whom he held, or the commission of waste might entail a like result as the effect of a judgment in an action of waste. The effect of disclaiming the title would be to enable the landlord to treat the tenant as a disseizor, and thus to forfeit his estate. In the U. S. the action of waste has been discarded in a number of the States, and even in those which still retain it an action to recover merely the damages sustained is more usually brought than one for forfeiture. One very important case of civil forfeiture is that which occurs when the breach of the condition in a grant has been committed. The grantor may re-enter upon the premises and recover them as his own property. (See CONDITION.) This form of forfeiture depends upon the stipulations of the parties, while other forms are referable to rules of law applying irrespective of any agreement.

Criminal forfeiture, under English law, was the general penalty inflicted for acts of felony and treason, the offender's lands, chattels, or both, being confiscated by the crown. (See FELONY.) The same penalty has been retained until the present, but with considerable relaxation of its former severity. Attainder for felony entails the entire loss of goods and chattels, but, except in the case of murder, the forfeiture of the criminal's interest in lands in such cases only extends to the profits accruing during his life, and afterward restoration of the land is made to relatives. When murder is committed the right of retaining and enjoying the profits of the land continues in the estate a year and a day after the wrong-doer's death, with power to commit waste. The only offense which now results in a complete confiscation of the offender's property, to be forever vested in the crown, is that of treason. There are a few minor offenses to which this kind of punishment is also attached. For instance, striking a person in the superior courts at Westminster, or drawing a weapon upon a judge there presiding, causes a forfeiture of the profits of the offender's land during his life. Forfeiture, in all cases after conviction and attainder, has a retrospective operation, so as to nullify all transfers or incumbrances that may have been effected since the commission of the offense.

In the U. S., forfeiture, as a general mode of punishment for crime, has never existed. There is a provision in the Constitution that "no attainder of treason shall work corruption of blood or forfeiture, except during the life of the person attainted." This restriction appears to have been copied in substance from the English statutes of 7 Anne, c. 21, and 17 Geo. II., c. 29. The language of the first of these acts is "that no attainder for treason shall extend to the disinheriting of any heir, nor to the prejudice of the right or title of any person or persons other than the right or title of the offender or offenders during his, her, or their natural lives only; and that it shall be lawful to every person to whom the right or interest of any lands, etc., after the death of any such offender should or might have appertained if no such attainder had been, to enter into the same" (sec. 10). Though this phraseology is much more explicit, it is altogether probable that the framers of the Constitution intended to accomplish the same result by a brief form of expression, and to save to the widow of a traitor her dower, and to the heir his estates. Of course it must be understood that this section of the Constitution applies to the result of judicial proceedings, and does not prevent Congress in the case of civil war from treating rebellious subjects as enemies under the law of nations, and seizing their property in that character. This limited authority to declare forfeiture for treason was never exercised until after the breaking out of the civil war in 1861. A previous law of Congress, passed in 1790, had expressly waived the right to impose such a punishment by providing that "no conviction or judgment for any capital or other offense shall work corruption of blood or any forfeiture of estate." The crisis of the civil war was thought to demand more stringent coercive and punitory measures, and in 1862 an act was passed providing for the confiscation of the property of certain classes of persons, but containing the restriction that no punishment or proceedings should be construed to work a forfeiture of the real estate of the offender longer than his natural life.

There are certain specific classes of offenses in regard to which particular statutes have been enacted by Congress exacting the forfeiture of property employed as a means of committing the wrongful act or used in an unlawful transaction; but forfeiture in such cases applies only to the particular property designated, and not generally to chattels or lands, as in the other instances which have been mentioned. Thus laws have been passed from time to time providing that smuggling or importation of goods under fraudulent invoices shall cause a forfeiture either of the entire invoice or of the property wrongfully imported. Acts of piracy entail a forfeiture of the piratical craft and its appurtenances. The same was formerly true of vessels engaged in the slave-trade.

The constitutions of many of the States of the Union, or the laws which they have enacted, contain substantially the same provisions, prohibiting the general forfeiture of a criminal's property, as the laws enacted by Congress.

Revised by T. W. Dwight.

Forfic'ula [Lat. *forficula*, small scissors]: See Entomology.

Forficu'lidæ: a family of insects the members of which have received in Great Britain the common name "earwigs." The scientific position which these insects should occupy is rather uncertain. Some authors place them in the order *Orthoptera*, along with the cockroaches, grasshoppers, etc., while others make a distinct order—*Dermaptera* or *Euplexoptera*—for them. See Entomology. J. S. K.

Forge [from O. Fr. *forge* < Lat. *fa'brica*, workshop, deriv. of *fa'ber*, smith]: a workshop and plant for the working by the hammer, or the hammer and rolling-mill combined, of wrought iron, steel, copper, etc., at a red or white heat. The Bloomary (*q. v.*) is often called a forge. The different forms of forge are very numerous, according to the kind of work to be turned out. The aid of steam is often called in, not only to furnish the air-blast, but to move powerful hammers, to hoist and turn masses of iron, and the like. The rolling-mill, a comparatively recent invention has for some purposes superseded the forge.

Forgery [from Fr. *forgerie*, deriv. of *forger*, make, form, devise < Lat. *fabrica're*, make, manufacture]: the wrongful making or alteration of a writing with intent to deceive and defraud by its fictitious appearance of genuineness. The essential criminality of the offense lies in its tendency to prejudice the rights and interests of innocent third persons, by giving to an instrument an apparent legal efficacy which it would not otherwise have possessed; and the application of this test as a criterion determines both the kind of writings of which forgery may be committed, and how great a degree of change is necessary to be effected in their form and appearance in order to constitute the crime. Thus the writing must be of such a nature that, whether fictitiously fabricated as a whole or only in part, its use and circulation would be calculated to occasion pecuniary loss or some infringement upon or injury to legal privileges, or the creation of a liability to which the person injuriously affected ought not to be subjected. The instrument must be legally capable of effecting a fraud. Hence if its only tendency would be to injure some person's feelings, violate his confidence, or convey false information, without otherwise affecting his interests, no forgery would be committed. But whenever the writing might be made the foundation of a legal liability, as if one should wrongfully make or alter a note or a bill of exchange, or wherever it might cause a wrongful disposition of property or occasion the loss of a situation of pecuniary benefit—in these and similar cases the unwarrantable falsification is sufficient to constitute the offense of forgery. Instruments which are manifestly of a pecuniary nature, by directly entitling their possessor to the receipt of money, may be forged, and a letter of recommendation to a servant or a schoolmaster by which he might obtain a lucrative position, or a representation as to the financial credit and standing of a merchant by reason of which those trusting him might be deceived, would come within the same category. The same is true of instruments which unwarrantably prejudice any legal right by effecting a fraud, as a deposition to be used on the trial of a cause in court or a copy of a writing to be used in evidence. If a writing be invalid on its face, it can not be the subject of forgery, since its power to prove deceptive would be nullified by its own contents. But the invalidity must be readily apparent, for if only discoverable upon examination—though but slight examination would be required—the criminal nature of the instrument is in no way diminished.

The degree of fabrication or alteration of an instrument need be only sufficient to render a fraudulent deception possible. Consequently, the entire contents need not be fictitious, but a very slight change, either by insertion, alteration, erasure, or other material modification of the terms of any writing, which would be effectual in giving it a seeming validity or varying its tenor, would be enough to constitute forgery. This may consist either in the addition of a false signature to a true instrument, or a real signature to a false one, in the insertion of paragraphs or clauses, or the change of words, or even of letters, if the legal effect of the instrument be thereby altered. Appending the signature of a fictitious person or of one no longer living to an instrument is as fraudulent an alteration as imitating the name of a person still living and generally known. A printed or engraved document, as a railroad-ticket or pass, may be forged, as well as one that is in writing; but when the thing in which the alteration is effected is one which does not consist, in its essential nature, of some form of language, no change of words used in connection with it will be sufficient to constitute a forgery. Therefore the change of an artist's name in the corner of a painting, in order to deceive the public, and fraudulently induce a purchase for more than its value, is not forgery.

As in other criminal offenses, an evil intent is a necessary element in the offense of forgery. But this principle does not require that there should have been a definite purpose to injure a particular person, but only that the instrument forged shall be intended to be used as if it were genuine. Consequently, if the wrong-doer in using the fictitious paper faithfully designs to take such subsequent measures as shall avert all possibility of injury, he is nevertheless guilty of the crime. By so employing the instrument that others may be defrauded he is conclusively presumed in law to have been actuated by criminal motives. But if a person, believing himself with good reason duly authorized to act as agent in the use of another's signature, does employ it, and has in fact no justification, he is not chargeable with forgery, because his wrongful act was induced by no fraudulent purpose. Generally, wherever an actual forgery is committed, intent is presumed from the mere circumstance that the act was committed.

It is not necessary that any actual injury should result from the offense. It is sufficient, at common law, that the writing has such a deceptive character that if once put into circulation it will, according to natural and reasonable anticipation, entrap and mislead those to whose hands it comes, to the injury of their lawful interests. Whether the person whose writing is imitated or whose name is assumed be immediately affected by the forgery, or loss is occasioned to third persons, is entirely immaterial. The offense is complete without regard to the persons affected.

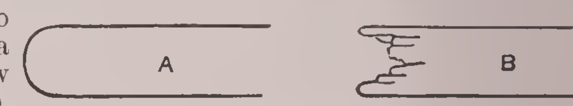
Besides forgery prejudicial to the rights of individuals, there exist, both at common law and by statute, varieties of this offense more immediately affecting the public. Of this nature are frauds and fraudulent alterations of any matter of record or of any authentic matter of a public nature, as a parish register, etc. Various statutes in Great Britain have specified numerous other instances in which fabrication or alteration of public documents is made punishable.

In the U. S., Congress and the State Legislatures severally have enacted special laws against forgery. This crime against the general Government can be punished only under the acts of Congress; but, as a general rule, it is held that the State statutes, unless inconsistent with the common law, do not supersede the principles of the common law, so that an offender may be prosecuted either under the statute or not, as may be thought desirable. Some States, however, have discarded the common-law procedure entirely.

The offense of uttering forged instruments—i. e. of attempting to effect a fraudulent deceit by making actual use of them—was not a necessary ingredient in the crime of forgery at common law, but was specifically provided for by statutory regulations. In some of the States uttering has been made an essential element in this offense, while in others it is still considered a distinct crime. (The statutes of the separate States must be consulted.) The word, as used in extradition treaties between the U. S. and foreign nations, would have a signification confined to that in which the word was employed in the general jurisprudence of the respective nations. It would not include the special statutory definition of forgery in one of the States. See EXTRADITION. Revised by T. W. DWIGHT.

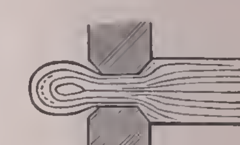
Forget-me-not: the *Myosotis palustris* of Europe, a plant of the Borage family, sparingly naturalized in the U. S., and prized by people of many nations as the emblem of constancy in friendship and love. The U. S. has a number of forget-me-nots, mostly common to the two hemispheres. They generally have brilliant blue flowers. Many varieties appear in cultivation; one of the most brilliant is the dark-blue forget-me-not of the Azores (*M. azoricura*), now widely cultivated in hothouses.

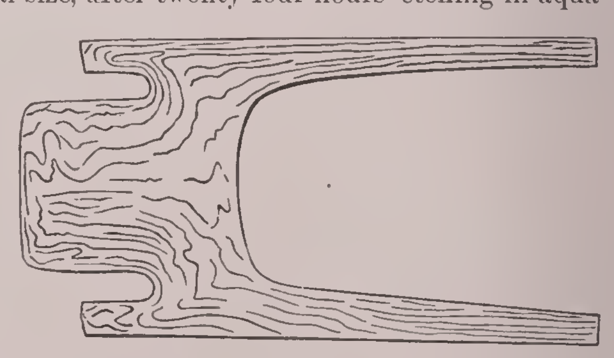
Forging: the reduction of iron or steel at a high temperature to any desired shape by means of blows of a hammer or the like. Originally all forging was done by hand, but now most kinds of work is done by the steam-hammer, and finished by hand in some cases. The rolling-mill has also superseded the forge to some extent, doing its work much more rapidly, and generally quite as well. In *hydraulic forging* the powerful and continuous pressure of a hydraulic press is substituted for the repeated blows of a hammer in shaping the iron or steel. A swedge, or mold, of the desired object is necessary, and under the proper conditions of temperature the metal may be forced into every angle and recess as perfectly as if made fluid by fusion and cast; but objects so made are very much stronger than castings, and are claimed to be even superior to forgings made in the ordinary way. The process has been carried to great perfection, after years of patient experimenting, by Mr. Haswell at the machine-shops of the Imperial State Railway Company of Austria, in Vienna. It is used there chiefly for forming such parts of locomotives as cross-heads, link-bars, axle-box frames, and for car-wheels and various other intricately formed parts of railway rolling-stock, where superior strength and lightness are important. It is also used instead of heavy steam-hammers for drawing down large ingots of Bessemer steel. The results appear to justify the conclusion that ingots so treated give stronger and more homogeneous bars than are obtained by hammering. At Vienna two large hydraulic presses were in use—one with a piston 24 inches in diameter, giving 1,200 tons pressure, and one with an 18-inch piston, working up to 600 tons pressure. The pressure in the pumps is 600 atmospheres. A press of more recent construction, made in France, exerts a pressure of 1,800 to 2,000 tons, and can be run at a speed of 30 squeezes a minute. A double press on the same plan, built at the Krupp works, and giving a maximum pressure of 6,000 tons, is used there for forging armor plates. The action is vertical; the piston descends upon the work, and for forging ingots has a hammer-like head opposed to an anvil of the usual form below. In drawing down an ingot, say of one ton weight, of soft Bessemer steel, the work begins at one end, and after each squeeze by the descending piston the mass is pushed along until the first half of the length of the ingot has been acted on, when it is turned end for end. It is then turned over and back and forth, as is usual under a hammer, until the whole has been drawn down to the required size. In this operation there is no noise or jar. The piston descends slowly, but irresistibly, and forces the hot metal each way as if it were a mass of soft putty. The work is effectively performed, and it requires less time than ordinary forging or rolling. The pressure affects the very center of the mass of the ingot. Its action is by no means superficial, and it is far more effectual in modifying the structural condition of the bar than blows on the surface can be. There is no distribution of the force of the blow through the anvil to the foundation, as there is in the violent impact of a steam-hammer. The ingot yields gradually to the pressure, and bulges out at the sides and end as in Fig. A, and is not drawn over more at the surface than at the center, so as to give a ragged hollow end (Fig. B),



such as is usually formed under hammers and rollers.

Before the forging of an ingot is completed a distinct structural arrangement of the steel is developed, and is seen most distinctly when the hot steel sinks down under the pressure. As the piston-head descends into the mass, and squeezes it upon the anvil, the lines of structure visible in the sides of the ingot bend downward, and are compressed as shown in the annexed cut, the movement extending to the very center of the mass. This structure or "fiber" is doubtless the result of a difference in chemical constitution in planes approximately parallel to the squeezing surfaces, and, so regarded, the process may be considered to be more favorable to the development of structure or "grain" than ordinary forging. But, from whatever cause it originates, this grain is an important factor of strength in pressed forgings, and characterizes them in a remarkable manner, as was beautifully exhibited at Vienna in a series of forged objects which had been sawn asunder and etched so as to show the grain. These structural peculiarities are most distinct in the pressed forgings made from piled iron masses, and are beautifully shown in etched sections of irregular angular objects like cross-heads, as in the figure, a section of a cross-head, about one-eighth natural size, after twenty-four hours' etching in aqua regia:





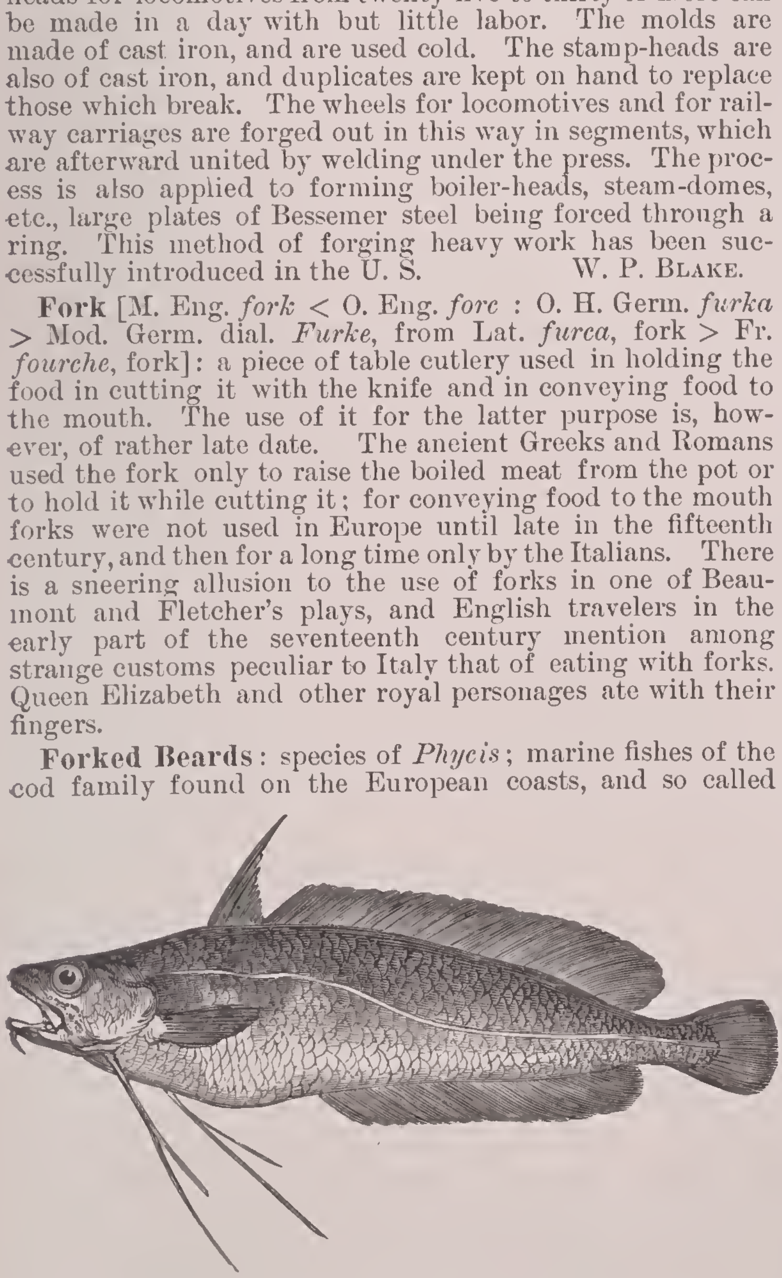
The lines of the grain, it will be seen, conform in a remarkable degree to the form of the mass, winding in and out around the curves and angles in such a manner as to give the greatest strength where it is most needed. These lines show in a very interesting way the flow or movement of the viscid metal when under pressure. Experience has taught that very sharp angles in some parts of molds interfere with the proper flow of the metal. This difficulty is avoided by rounding off the angles, or by building them out so as to give more space for the metal to move in. The superfluous metal is cut away, leaving the internal curves of the grain in the best shape for the strength of the object.

In forging such objects as the parts of machines weighing from 50 to 150 lb. or more, a mass or ball of metal is cut as nearly as possible of the required weight from the end of an ingot, and is heated nearly white hot preparatory to being thrown into the mold. The molds are made of iron or steel, in several parts if necessary, and these parts are securely held together by bands of wrought iron. They are left open at the top for the reception of the metal and for the descent of the plunger or follower, which is attached to the piston-head of the hydraulic press. The shape of this follower, called by the workmen the "stamp," determines the shape of the inside of the object to be formed. The mold is placed directly under the piston-head. All the parts being properly adjusted, and the inside of the mold and the surface of the plunger being smeared with thick oil or grease, a mass of hot steel is thrown into the open top of the mold; the plunger is brought slowly down, and pushes the hot metal before it into every part and recess of the mold. The excess of metal, if any, after the mold is filled, rises on each side of the plunger and protrudes. This leaves a wing or "burr," which is afterward easily cut off with chisels; but a little practice enables the workmen to cut off masses so near the required weight that there is but little excess to be trimmed off. When the stamp has reached the required depth the pressure is removed; the key which attaches the stamp-head to the piston is knocked out; the piston is raised out of the way, and the mold and contents are removed from the bed of the press. A few blows of a sledge-hammer detach the fastenings of the mold and liberate the forging, which is thrown aside to cool. If the work has been well done, all the angles of the object are full and solid. All pieces pressed in the same mold are alike in dimensions, and there is no great excess of metal in any part to be cut away.

The rapidity with which intricate forgings are made is one of the greatest advantages of the method. It is especially adapted to heavy work, where there are many angles and interior surfaces to be shaped. Of such objects as cross-heads for locomotives from twenty-five to thirty or more can be made in a day with but little labor. The molds are made of cast iron, and are used cold. The stamp-heads are also of cast iron, and duplicates are kept on hand to replace those which break. The wheels for locomotives and for railway carriages are forged out in this way in segments, which are afterward united by welding under the press. The process is also applied to forming boiler-heads, steam-domes, etc., large plates of Bessemer steel being forced through a ring. This method of forging heavy work has been successfully introduced in the U. S. W. P. Blake.

Fork [M. Eng. *fork* < O. Eng. *forc* : O. H. Germ. *furka* > Mod. Germ. dial. *Furke*, from Lat. *furca*, fork > Fr. *fourche*, fork]: a piece of table cutlery used in holding the food in cutting it with the knife and in conveying food to the mouth. The use of it for the latter purpose is, however, of rather late date. The ancient Greeks and Romans used the fork only to raise the boiled meat from the pot or to hold it while cutting it; for conveying food to the mouth forks were not used in Europe until late in the fifteenth century, and then for a long time only by the Italians. There is a sneering allusion to the use of forks in one of Beaumont and Fletcher's plays, and English travelers in the early part of the seventeenth century mention among strange customs peculiar to Italy that of eating with forks. Queen Elizabeth and other royal personages ate with their fingers.

Forked Beards: species of *Phycis*; marine fishes of the cod family found on the European coasts, and so called



Great forked beard.

from their forked ventral fins, the rays of which are very slender, like barbels. The forked beards of the U. S. waters (*Phycis chuss* and *tenuis*) are called hake, but are much superior in quality to the true hake.

Forkel, Johann Nikolaus: German musical composer and author; b. at Meeder, near Coburg, Feb. 22, 1749; studied at Göttingen 1769–79; was director of music to the university in 1779; member of the academy of Stockholm 1804. Published *General History of Music* (2 vols., 1788–1801, unfinished); *Life of Sebastian Bach* (1803; new ed. by Peters, 1855); and other works. D. at Göttingen, Mar. 17, 1818.

Forlì, fōr-lē′: province of Italy; on the Adriatic; area, 719 sq. miles. Its coast region is low and unhealthful, but very productive. Sulphur is mined, and the manufacturing interests are important. Pop. (1890) 274,042.

Forlì (anc. *Forum Livii*): town of Italy; capital of the province of Forlì; beautifully situated between the rivers Ronco and Montone; at the foot of the Apennines; in the center of a fertile and well-cultivated plain; 40 miles S. E. of Bologna (see map of Italy, ref. 4–D). It is handsomely built, and contains a number of interesting monuments—the cathedral, with the beautiful chapel of the Madonna del Fuoco, where is found the masterpiece of Carlo Liguani, the Church of S. Girolamo, with frescoes by Melozzo da Forlì, and a *Conception* by Guido Reni, etc. It has also many excellent educational and charitable institutions, and manufactures of silk ribbons, oil-cloth, matches, and tiles. It was founded in the third century before Christ. After the fall of the West-Roman empire it became a republic with an oligarchic form of government, generally with some great family at its head, but in 1503 Julius II. conquered it, and from then till 1860 it was incorporated with the Papal States. Pop. (1895) 45,200.

Forlì, Melozzo, da: painter; b. in Italy in 1440; generally supposed to be a pupil of Piero della Francesca. Although of wealthy parentage, he apprenticed himself as workman to a great master in order to learn his art. Little is known about his life, although he contributed greatly to the progress of art. One of his best works, in the chapel of the SS. Apostoli at Rome, in which he represents our Savior's ascension, was executed in 1472. Besides many works in Rome he painted at Forlì, his native place; Ferrara also possesses exquisite fragments of his painting. D. in 1492. W. J. S.

Form [M. Eng. *forme*: Germ. *Forme*, *form*, from O. Fr. *forme* < Lat. *forma*, shape, form]: in philosophy, the essence of a thing; that which makes a thing what it is, and is permanent. The history of this as a philosophical term begins with the doctrine of Pythagoras respecting numbers. In them is to be found the first dawn of the thought of a principle of form, which was developed by Socrates and Plato into the famous doctrine of ideas (= forms, εἴδη ἰδέαι). To these, in opposition to Heraclitus's theory of universal flux, Plato assigned an independent and eternal existence (Aristotle, *Metaph.*, bk i., cap. vi.), and made them the archetypes of which individual things are the more or less imperfect copies, existing through participation. Aristotle severely criticised the Platonic doctrine, denying the independent existence of archetypal *forms*, and making *form* one of the four αἰτίαι, or grounds of existence. He, however, uses the term in a narrower and in a wider sense. In the former it is the second of the αἰτίαι, constituting, as the inner principle of realization (distinguished from μορφή, or external form), the substance of things. In its wider signification it includes formal, efficient, and final causes, and thus stands opposed to the material principle as actuality to potentiality. In this sense the spiritual is pure form, and the soul the "form of forms." (See Biese, *Philosophie des Aristoteles*, vol. i., p. 439; Trendelenburg, *Aristotelis de Anima lib iii.*, pp. 301, *seq.*; Bonitz, *Aristotelis Metaphysica*, p. 325, *et passim*; Von Hertling, *Materie und Form*, pp. 48, *seq.*; Ueberweg, *Hist. of Philosophy* (Eng. trans.), vol. i., p. 162; Grote, *Aristotle*, vol. i., p. 354; vol. ii., p. 354, *et al.*; Lewes, *Aristotle*, p. 117.) The term underwent little change of meaning until the time of the Neoplatonists, who tried to fuse the teachings of Plato and Aristotle. In Plotinus, *form*, instead of being conceived as an αἰτία, is placed in the category of substance, constituting, along with matter (ὕλη) which is not regarded as its substratum merely, substance. (Plotin., *Enneads*, ii., bk. iv.; Kirchner, *Die Philosophie des Plotin.*, pp. 106, *seq.*; Richter, *Plotin's Lehre vom Sein*, pp. 96, *seq.*) The Scholastics were mostly guided by the authority of the ill-understood philosophy of the ancients, especially of Aristotle.

Robert Greathead, for example, who wrote commentaries on Aristotle, distinguished three kinds of forms—form immanent in matter, abstract form, and immaterial form. Albertus Magnus held that form existed potentially in matter; and Thomas Aquinas recognized a *forma substantialis*, or objective universal, and *formæ accidentales*, or subjective abstractions. With him, as with Aristotle, God is pure form—immaterial, as being entirely actual, without potentiality.

Bacon, the most successful of the opponents of Scholasticism, flattered himself that he had broken with antiquity more than he really did. He identified form with law or mode, and even maintained that, as far as thought is concerned, the form of a thing is the very thing itself. (*Nov. Org.*, ii., 13.) The philosophy of Bacon and Locke came to a standstill with Berkeley and Hume, and the reaction called forth on one hand the Scotch or common-sense philosophy—on the other, the Kantian or critical philosophy. In the latter the word *form* has a purely transcendental meaning—that is, the forms, whether of intuition or of thought, are regarded as native to the mind and prior to experience. The *forms* of intuition are space and time. The *forms* of thought are (*Proleg.*, pt. ii., § 20):

1. QUANTITY.	2. QUALITY.	3. RELATION.	4. MODALITY.
Unity,	Reality,	Substance,	Possibility,
Plurality,	Negation,	Cause,	Existence,
Totality.	Limitation.	Reciprocity.	Necessity.

These categories of the understanding stand opposed to the transcendental object or *Ding an sich* (thing in itself), which corresponds to the Aristotelian ὕλη, but is treated less philosophically. Since Kant, this has been the meaning of *form* in German philosophy, except that since Hegel *form* has been conceived as objective as well as subjective, pure knowing being identical with its object. In the Scotch and modern materialistic and cosmic schools the word has no true philosophic meaning. Thomson calls *form* "the means of viewing objects presented to the mind." *Outline of Laws of Thought*, 2d (English) ed., p. 34. THOMAS DAVIDSON.

Formal Cause: in philosophy (Aristotle, *Metaphys.*, v., 2), the form, archetype, idea, or pattern of anything. Thus the intention or design (idea) of the artist is a formal cause of the statue. The formal cause is the *quidditas* of the Schoolmen.

Formates: salts of formic acid.

Formation: in geology. See BED and GEOLOGY.

For'mes, KARL: singer; b. at Mülheim-on-the-Rhine, Aug. 7, 1810; made his first appearance on the stage Jan. 6, 1842, at Cologne as Sarastro in *The Magic Flute*. He sang with great success in Vienna, London, and other European capitals. In 1857 he went to the U. S. and led a wandering life, dying in San Francisco, Dec. 15, 1889. His voice was a deep and powerful bass of high culture and great flexibility. D. E. HERVEY.

For'miæ: a city of ancient Italy, on the site of the town now called *Formia*. Its origin is unknown. It was on the Appian Way and on the Sinus Caietanus, and has always been famed for its beautiful situation. Cicero and many other Romans had villas here, and at Formiæ the great orator was murdered. A structure called the tomb of Cicero is still shown.

Formic Acid [*formic* is from Fr. *formique*, deriv. of *fourmi*, ant (but subjected anew to the influence of its original), Lat. *formi'ca*, ant]: $HCHO_2$, the simplest member of the fatty series of acids, derives its name from the ant (*formica*), from which it was first prepared. It occurs in the juice of the stinging nettle and in other plants; in the ant, especially the red ant, and is projected by it as a means of defense; in some caterpillars; in human blood, urine, flesh-juice, and perspiration; in some waters. It is formed by a great variety of chemical reactions. Potassic hydrate heated in carbon monoxide is changed to potassic formate—$CO + KHO = KCHO_2$. Potassium spread on the inner surface of a jar of carbon dioxide over water is converted into a mixture of potassic formate and acid carbonate—$CO_2 + K_2 + H_2O = KCHO_2 + KHCO_3$. Wood-spirit (wood-naphtha or methylic alcohol) is oxidized in presence of platinum black into formic acid—$CH_4O + O_2 = HCHO_2 + H_2O$. It is prepared (1) by distilling red ants, previously mashed; (2) by distilling 10 parts of tartaric acid, 14 parts of manganese dioxide, and 35 parts of water; (3) by distilling 1 part of starch with 4 parts of water, 4 parts of manganese dioxide, and 4 parts of sulphuric acid, added in small quantities; (4) by gently heating 10 parts of oxalic acid, with 10 of glycerin and 2 of water, to about 212° F. for twelve or fifteen hours, then adding 5 parts of water and distilling. The addition of water and distillation are repeated till 60 parts of the dilute acid have been distilled off. The pure concentrated acid is prepared by saturating the impure dilute acid with plumbic carbonate, crystallizing the plumbic formate, and heating it in a current of sulphuretted hydrogen. The formic acid distills over, and may be freed from sulphuretted hydrogen by a current of carbon dioxide. The concentrated acid is a thin, transparent, colorless liquid, sp. gr. 1·22, boiling at about 212° F. It fumes in the air, and is very corrosive, a single drop placed on the skin causing intolerable pain and producing a painful ulcer. It (or its salts) reduces the oxides and many of the salts of mercury, silver, and gold, forming metallic precipitates.

Formication [from Lat. *formica'tio*, deriv. of *formica're*, crawl like ants, deriv. of *formi'ca*, ant]: one of a group of unnatural sensations felt in the skin to which the general term *paræsthesia* is applied. Formication is so called from the resemblance of the sensation to that produced by the crawling of ants. It is frequently experienced as a result of pressure on the nerves of the leg or arm, the foot or hand being said to be "asleep." It may also be present as a temporary symptom in poisoning by aconite. As a more permanent symptom formication, together with other forms of paræsthesia, such as burning sensation, feeling of water running over the skin, etc., occurs in various forms of spinal disease. All of these symptoms may or may not be associated with *anæsthesia*, the loss of sensation in the skin.
WILLIAM PEPPER.

Formo'sa, or **Bermejo**: a territory of Argentina; created in 1884 from the northern part of the old territory of Chaco; bounded N. E. and E. by the rivers Pilcomayo and Paraguay, separating it from Paraguay S. W. by the river Bermejo, separating it from Chaco, W. by Salta, and N. by Bolivia. Area, 73,000 sq. miles. Physically it is entirely comprehended in the great plain of the GRAN CHACO (*q. v.*), and the interior is very imperfectly known. Pop. (1895) 4,829, exclusive of wild Indians. Villa Formosa, the capital and only civilized town, on the Paraguay, has 1,000 inhabitants, and is the center of an agricultural colony. H. H. S.

Formosa: a large and important island which belonged to China until 1895, when it was ceded to Japan by the Treaty of Shimonoseki. It lies about 90 miles E. of the Chinese province of Fuhkien, of which it was a foo or department until 1886, when, with the Pescadores and other adjoining islands, it was erected into a separate province. Among the Chinese it is called *Taiwan*, or "Terrace Bay," the name *Formosa*, "the beautiful," by which it is known to foreigners, having been given to it by the Portuguese, the first Europeans to visit it, near the close of the sixteenth century. See TAIWAN.

Area, Topography, etc.—The island stretches in a general N. E. and S. W. direction from 25° 19' to 21° 54' N. lat. It is 237 miles in length, has an average breadth of 70 miles, and an estimated area of about 15,000 sq. miles. The southern half lies within the tropics. It has two well-marked physical divisions: (1) a plain about 20 miles in breadth, extending along the west coast for nearly the whole length of the island, and (2) a great forest-covered mountain-system which occupies the rest of the island. Through the center of this region runs a chain of lofty peaks, of which Mt. Sylvia (11,500 feet) and Mt. Morrison (12,850 feet) are the chief. The east coast is bold and precipitous, the mountains in some places rising sheer out of the water to a height of 6,000 to 7,000 feet. The water off shore is consequently very deep, while on the west coast it is remarkably shallow. There are no harbors and few good anchorages on either of these coasts.

Tamsui and Kelung in the north, at the mouths of the Tamsui and Kelung rivers respectively, afford the best harbors.

Geology.—Little is known of the geology of the island. The mineral products include coal, sulphur, and petroleum; and iron ore, gold, and silver are also found. The coal, which is a soft bituminous, is abundant and of good quality. Since 1877 it has been extensively mined near Kelung by the Chinese Government, under foreign superintendence. The petroleum wells, also found in the north, are still undeveloped.

Soil and Productions.—The soil is rich and very productive, and vegetation is exceedingly luxuriant. Bamboos of great size abound, and the mountains are covered with forests of gigantic camphor-trees (*Laurus camphora*) and other valuable timber-trees. The principal agricultural products are rice (two crops yearly), wheat, barley, millet, maize, pulse, yams, peanuts, etc. Among the other products are tea, sugar, tobacco, indigo, jute, hemp, ramie or China-grass, etc. The tea, which is grown in the north, is superior to that of Japan, but inferior to that grown on the mainland. The U. S. take most of it. The sugar is of two kinds, and goes mostly to Japan. Much camphor-wood is exported, and the trade in camphor is considerable. The product in 1890 amounted to 100,833 piculs. Until Feb. 9, 1891, the camphor-trade was a Government monopoly. A license is necessary, and a garrison tax is levied by the Government to defray the expense of maintaining troops in the interior to protect the stills and workmen from attack and injury by the aborigines.

Climate.—Though partly within the tropics, the heat is never excessive. At Taiwan-fu (see TAINAN), the present capital, the atmosphere is clear and bracing, and the cold is never as great as at Hongkong, which lies farther S. In the north, and especially about Tamsui, the rainfall is great, and the rainy season lasts from the end of November to the beginning of May. The temperature is higher than in the same latitude on the mainland, but the dampness of the air makes it unpleasantly cold.

Population and Races.—The population of the island, usually estimated at 3,000,000, is composed (1) of settlers from the mainland of China, chiefly from Fuh-kien and Kwang-tung, and (2) native or aboriginal tribes of distinctly Malay type, who now occupy the mountainous regions and the east coast. The Chinese settlers occupy the plain which borders the west coast and the regions of the north, while between them and the uncivilized aborigines are found HAKKAS (*q. v.*) and Hoklos, also immigrants from China, who live in towns and villages of their own, as well as the semi-civilized aborigines, with whom they, as well as the Chinese, frequently intermarry. The independent tribes who do not recognize Chinese authority are usually known as *Sŭng-fan* (locally *Chi-hwan*), "raw" or untamed foreigners; while those who have been brought under civilizing influences are known as *Suh-fan* (locally *Sek-hwan*), "cooked" or tamed foreigners, or as *Pepo-hwan*, "foreigners of the plain." The aborigines (who now number about 60,000) are divided into numerous clans, and speak several distinct dialects. They are tall and active, and have given much trouble to the Chinese settlers. Tattooing is in vogue among them.

Trade and Commerce.—Four towns were opened by the Chinese to foreign trade and Japan continues the arrangement, viz.: TAIWAN-FU (*q. v.*); TAKOW (*q. v.*), 22 miles farther S.; TAMSUI (*q. v.*), on the northwest coast; and KELUNG (*q. v.*), on the north. The net foreign imports, cottons, woolens, lead (for tea-chests), matches, kerosene, etc., amounted in 1892 to 3,745,158 haikwan taels, and the exports, comprising coal, tea, rice, sugar, camphor, gold-dust, beans, hemp, etc., to 4,459,829 haikwan taels. See FORMOSA in the Appendix.

History.—Formosa seems to have been known to the Chinese as early at least as the Sui dynasty (581–618), an expedition having been sent to it in 603. It was not until 1683, however, that Chinese authority was established there. Attempts seem to have been made by the Spanish to establish settlements in the north. During the period Wan-leih (1571–1619) of the Ming dynasty the Japanese took possession and held part of the island, but were driven out by the Dutch, who had gained a footing on the Pescadores, in 1621, and later on the main island, where, in 1624, they built a fort called *Zealandia*, and another named *Providentia*, at the principal harbor on the west coast (now called Taiwan). After many conflicts with the aborigines on the one hand, and on the other with the Chinese settlers who flocked to Formosa from Fuh-kien during the troubles connected with the overthrow of the Ming dynasty by the Manchus, and especially with KOXINGA (*q. v.*), a famous pirate chieftain, the Dutch were forced to withdraw in 1662, and Koxinga proclaimed himself king. During the K'ang-hi period the title of king was abolished and a governor was appointed, but it was not until 1683 that the island passed into the full control of the Chinese Government, by the surrender by the grandson of Koxinga of all claim to it.

Formosa was again opened to foreign trade and residence by the treaty of Tientsin (1860). Roman Catholic missions were first established there in 1859, and Protestant missions in 1865, and their success has been very great. Traces are still found of the Christian work carried on by the Dutch. In 1874 the Japanese sent an expedition to Formosa to punish the natives for the massacre of the crew of a Japanese vessel that had been wrecked on the coast in 1872, and a war with Japan was averted only by the Chinese agreeing to pay half a million taels to the friends of the murdered men, and by purchasing the buildings the Japanese had erected during their occupancy of the coast. In 1885, when the French captured Kelung and endeavored to take possession of the island, the governor removed his capital to Tai-pak-fu, which is practically a part of the important city of Twatutia, 10 miles from Tamsui and 30 by rail from Kelung. From Twatutia the railway runs S. as far as Sin-chu (about 35 miles), and is being pushed farther S. still. In Nov., 1895, Taiwan-fu (see TAINAN) again became the capital. The telegraph has been introduced, and a cable connects the island with Fuh-chow. See Appendix. R. LILLEY.

Formo'sus: Bishop of Porto; became pope in 891; d. May 23, 896. His election caused much controversy during and after his pontificate, as the canons at that time forbade a transfer of bishops from one see to another; and Pope Stephen VI. caused his body to be dug up and cast into the Tiber as an intruder, but a council, presided over by John IX., declared the pontificate of Formosus valid and confirmed his acts as pope.

Forms of Address: the titles to be used in addressing written communications to individuals. In European countries and in all countries where rank and title prevail the forms of address to be followed are a matter of much complexity. In the U. S. these forms are less varied and numerous, and an adherence to them is not so absolute. Common usage has sanctioned the employment of the following forms: The President of the U. S., Governors of States, and ministers to foreign countries are addressed as "His Excellency the President of the United States," etc. This custom is now sanctioned by law. Vice-President, heads of executive departments at Washington, chief justice of the U. S., Lieutenant-Governors of States, and mayors of cities, "The Honorable the Vice-President of the United States," etc., or "The Hon. —— ——, Vice-President of the United States," etc. Senators and Representatives of the U. S., or of the several States, judges, and consuls, "The Hon. —— ——," to which may be added their official designation.

Ex-Presidents and other ex-officials are addressed simply as "The Hon. —— ——."

Usage differs as to the title "Honorable" in different parts of the U. S. In New England the title is limited quite strictly to State officers, members of Congress, judges, State Senators, and mayors of cities, and is not usually given to members of the lower house.

Cardinals: "His Eminence —— ——, Cardinal Priest (or Cardinal Deacon, as the case may be) of the Holy Roman Church."

Archbishops: "The Most Rev. —— ——, D. D."

Bishops in the Roman Catholic and Episcopal Churches: "The Right Rev. —— ——, D. D."; in the Methodist Church: "The Rev. Bishop —— ——, D. D."

Ministers of the gospel: "The Rev. —— ——," or "Rev. —— ——."

Physicians and surgeons: "Dr. —— ——," or "—— ——, M. D."

Lawyers or private gentlemen: "—— ——, Esq.," although in the case of unprofessional gentlemen a plain "Mr. —— ——" is quite usual. The latter form is always used in invitations, and is gaining in favor in common addresses. In addressing both husband and wife the accepted forms are: "His Excellency and Mrs. U. S. Grant"; "Governor and Mrs. John A. Andrew"; "The Hon. and Mrs. Thomas H. Benton"; "The Rev. and Mrs. John Brown," etc. Widows write their names "Mrs. Ellen Smith," not "Mrs. John Smith." For some account of British usage, see COURTESY TITLES.

Forney, JOHN WEISS: politician and journalist; b. at Lancaster, Pa., Sept. 30, 1817; apprenticed in the office of the Lancaster *Journal* in 1833, and in 1837 was editor and joint proprietor of the Lancaster *Intelligencer*; in 1840 he united the two papers. In 1845, in Philadelphia and thereafter, he edited *The Pennsylvanian*, Democratic journal. In 1851–55 was clerk of the U. S. House of Representatives, editing the Washington (D. C.) *Union*, Democratic. Aug. 1, 1857, began *The Press*, Democratic daily, at Philadelphia, supporting Stephen A. Douglas and opposing President Buchanan. He was subsequently clerk of the Thirty-sixth

Congress. At the opening of the civil war in 1861 he urged the vigorous prosecution of the contest by the Northern States, and acted with the Republican party until the nomination of Mr. Greeley, whose election he advocated. From 1861–68 he was secretary of the U. S. Senate and corresponding editor of the *Press*; started during this time the Washington (D. C.) *Chronicle*, weekly, which became a daily in Oct., 1862; visited Europe in 1868, publishing his letters to the *Press* and *Chronicle* as *Letters from Europe* (1869). Sold his property in the *Chronicle* in 1870, but was connected with the *Press*, and later established *Progress*, a weekly journal. D. in Philadelphia, Dec. 9, 1881.

Fornication [from Lat. *fornica'tio*, deriv. of *fornix*, vault, brothel]: unlawful carnal knowledge by an unmarried person of another, whether the latter be married or unmarried. It is usually a misdemeanor, punishable by fine or imprisonment or both.

Forrest, Edwin: actor; b. in Philadelphia, Pa., Mar. 9, 1806. When a mere boy, not twelve years old, he performed as an amateur, taking female and juvenile parts, Young Norval in Home's play of *Douglas* being particularly remembered. His first appearance on the public stage was at the Walnut Street theater, in the *rôle* of Douglas, on Nov. 27, 1820. A long professional tour in the Western cities, during which he undertook characters in Shakspeare, gave him experience and reputation; so that, after filling engagements in Albany and Philadelphia, he presented himself before the New York public at the Park theater in the character of Othello. This was in 1826. His success was signal, owing both to his natural genius and to his superb form and noble presence. At the Bowery he was a special favorite. There and at the Park he played long engagements, but, not satisfied with local fame, visited all the principal cities of the U. S. His chief characters were Othello, Macbeth, Hamlet, Richard III., varied by parts like Metamora and Spartacus, which his fine physique and immense energy made effective and kept popular. In 1835 Mr. Forrest made a professional visit to England and the Continent, finding warm friends, conspicuous among whom was Mr. Macready, to whom he was indebted for much kindness. In 1837, on the occasion of a second visit, he married Catharine Sinclair, daughter of the popular ballad-singer. After 1845 two years more were spent in England. During this visit his friendly relations with Mr. Macready were broken. His partisans entered zealously into the quarrel, which broke out in the bloody riot of May 10, 1849, when Macready was playing at the Astor Place theater in New York. Mr. Forrest announced his retirement from the stage in 1858, but played at intervals till 1871, when compelled by ill-health to desist. After this he appeared as a public reader of Shakspeare. He was a man of fine literary taste and accumulated a large library rich in Shakspeariana. He died in Philadelphia, Dec. 12, 1872. A large part of his great fortune was left by him to establish an asylum for aged and indigent actors. His library, with its best treasures, was destroyed by fire Jan. 15, 1873. See the *Life* by W. R. Alger (1875), and the biography by Lawrence Barrett in the American Actor Series (Boston, 1883).

Forrest, French: naval officer; b. in Maryland in 1796; became a midshipman 1811; lieutenant Mar. 5, 1817; commander Feb. 9, 1837; captain Mar. 30, 1844; and was dismissed Apr. 19, 1861. He distinguished himself in the war of 1812 on Lake Erie, and in the fight between the Hornet and the Peacock Feb. 24, 1813. In the Mexican war was adjutant-general of the land and naval forces. Followed the State of Virginia when she seceded from the Union, and was acting assistant secretary of the Confederate navy. D. at Georgetown, D. C., Dec. 22, 1866.

Forrest, James: secretary of the Institution of Civil Engineers of Great Britain; b. in London, Nov. 30, 1825. He received an ordinary school education, and at the age of sixteen was articled to Messrs. Edward and John Manby, civil engineers, and when their office was removed to Paris he was transferred to that of Mr. Charles Manby, at that time secretary of the Institution of Civil Engineers. From 1845 to 1848 Forrest was engaged upon the Leeds and Dewsbury, the Leeds and Thirsk Railways, the East and West Yorkshire lines and others, under Mr. Thomas Grainger. In 1848 he returned to Mr. Manby, assisting him in the work of the institution. In 1858 he was made assistant secretary of the Society of Arts; in 1856 succeeded Mr. Manby as secretary of the institution. He has been intrusted with the most responsible and confidential work, and has brought into the institution many improvements. During his incumbency the membership has risen from 835 to 6,339, and the income from £3,000 to £25,000. It had been the policy of the older members to limit membership to those engaged in the constructive branch of engineering, excluding, for instance, men who were occupied in the design and construction of machinery. This exclusiveness was resented and led to the formation of the Institution of Mechanical Engineers. Mr. Forrest set himself to induce the council to take the broader view, so that the institution might become the representative of the whole engineering profession, a result which was not fully accomplished until 1886. He is also the actual treasurer, librarian of the extensive library, and personal editor of the *Proceedings*.

W. R. Hutton.

Forrest, Nathan Bedford: soldier; b. in Bedford co., Tenn., July 13, 1821. In 1834 his father removed to Mississippi, and in 1837 died, leaving a large family dependent upon Nathan, who devoted himself to farming. He engaged in business at Hernando, Miss., in 1842; in 1852 became a real-estate broker and dealer in slaves; in 1859 purchased extensive plantations in Coahoma co., Miss., and became a cotton-grower, and acquired a large fortune. Though opposed to disunion, he was an ardent States rights man in politics, and when war became inevitable he espoused the Southern cause with his usual energy. In June, 1861, he joined the Tennessee Mounted Rifles as a private, but in July, at the request of Gov. Harris, of Tennessee, raised a regiment of cavalry, equipping them largely from his own private means. On the organization of the regiment in October he was chosen lieutenant-colonel. At Fort Donelson Forrest bore a conspicuous part, and on the final determination to surrender he remonstrated, and was allowed to attempt an escape with his men before a flag of truce was sent. In this he was successful, reaching Nashville with the main part of his force Feb. 18. On Mar. 10 his regiment reassembled at Huntsville, and a few days later marched to Iuka, Miss. His force was now increased to ten companies, of which he was chosen colonel. Engaged at the battle of Shiloh (Pittsburg Landing) Apr. 6–7, 1862; wounded in combat Apr. 8. In the following June he was assigned to the command of cavalry at Chattanooga, and participated in the attack on Murfreesboro July 13; appointed brigadier-general July 21, 1862, and placed in command at Murfreesboro Sept., 1862; in command of brigade Dec. 4, 1862, and engaged in the action of Parker's Cross-roads Dec. 31, 1862, and battle of Chickamauga Sept. 19–20, 1863. Transferred to North Mississippi in Nov., 1863, he was appointed a major-general the following month, and assigned to the command of Forrest's cavalry department; in command of forces at the capture of Fort Pillow Apr., 1864; promoted to be lieutenant-general Feb., 1865; surrendered at Gainesville May 9, 1865; was subsequently president of Selma, Marion and Memphis Railroad Company until 1874. D. at Memphis, Tenn., Oct. 29, 1877.

Forrest City: town and railway junction; capital of St. Francis co., Ark. (for location of county, see map of Arkansas, ref. 3–E); 45 miles W. by S. of Memphis, Tenn. It has 6 churches, 2 free schools (one for blacks), and a canning-factory. Principal industries, agriculture and stock-raising. Pop. (1880) 903; (1890) 1,021; (1900) 1,361.

Editor of "Times."

Forrester, Alfred Henry (*Alfred Crowquill*): artist and comic writer; b. in London, England, in 1805; educated at Islington; was a notary in the Royal Exchange, but retired about 1839; began contributing to periodicals at the age of sixteen, and afterward drew, modeled, and engraved on steel and wood to illustrate his own writings. *Leaves from my Memorandum-book* (1826) was followed by *Eccentric Tales* (same year.) In 1828 he contributed to the *Humorist* in *Colburn's Magazine*, with Theodore Hook, Disraeli, and others; then to *Bentley's Miscellany*, *Punch*, *The Illustrated London News*, etc. He exhibited large pen-and-ink drawings at the Royal Academy, and gained some repute as a designer and modeler. *Wanderings of a Pen and Pencil*, *The Comic Arithmetic*, *Phantasmagoria of Fun*, etc., are among his works. D. in London, May 26, 1872.

Forreston: village (founded in 1854); Ogle co., Ill. (for location of county, see map of Illinois, ref. 2–E); 107 miles W. of Chicago. It is the terminus of the Ch. and Ia. Branch of the Ch., B. and Q. Railroad, and the junction of the Ch., Mil. and St. P. and the Ill. Cent. Railroads. It has seven churches, a public school with an attendance of 300 pupils, and a creamery. Principal business, farming. The village was incorporated Sept. 21, 1867; under special charter May 11, 1868; under general law Aug. 2, 1888. Pop. (1880) 1,108; (1890) 1,118; (1900) 1,047.

EDITOR OF "HERALD."

Forshey, Col. CALEB GOLDSMITH, A. M.: engineer; b. in Somerset co., Pa., July 18, 1812; educated at Kenyon College, O., and at the U. S. Military Academy at West Point; was Professor of Mathematics and Civil Engineering at Jefferson College, Miss., 1836–38; was thenceforth engaged for many years in important engineering works in the South. Though opposed to secession, he served in the Confederate army during the civil war as lieutenant-colonel of engineers. After the war he was engaged in railway construction in Texas 1865–71, on the improvements at the mouth of the Mississippi, and in the U. S. engineer service on the Red river and in Galveston Bay 1874–75. Prof. Forshay was one of the founders of the New Orleans Academy of Sciences 1853, and was its first vice-president. He was one of the authors of *The Physics of the Mississippi River* (Washington, 1861; 2d ed. 1876). D. at Carrollton, La., July 25, 1881.

Förster, ERNST JOACHIM: painter and writer on the history of art; b. at Münchengosserstadt, Germany, Apr. 8, 1800. His early studies were in theology, philosophy, and philology in the universities of Berlin and Jena, but at the age of twenty-three he devoted himself to painting, under the teaching of Cornelius, one of the founders of the school of which Kaulbach was the most distinguished pupil. Förster's hand is seen in frescoes in the Aula at Rome, in the Glyptothek and Arcade at Munich, and in the chapel of San Georgio at Padua, whose frescoes he restored. But his chief labor was literary. He wrote a large number of works, including a *History of German Art* (3 vols., 1851); *History of Italian Art* (1869); *Studies Relating to the History of Modern Art* (1835); *Letters on Painting* (1838); *Monuments of German Architecture, Sculpture, and Painting* (1855); *History of Modern German Art* (1863); *Life of Raphael* (1867–69); *German Art in Picture and Story* (1879); and guide-books to Munich, Italy, and Germany of great merit. He also wrote a *Life* of Jean Paul Richter, and edited several of his works. Förster was the discoverer of several ancient pictures in Italy, notably of the old frescoes of Avanzo in Padua, which he restored. D. at Munich, Apr. 29, 1885.

Forster, JOHANN GEORG ADAM: traveler and author; b. near Dantzic, Germany, Nov. 26, 1754; accompanied his father, JOHANN REINHOLD FORSTER (*q. v.*), around the world in 1772–75; was Professor of Natural History at Wilna in 1784, and librarian to the Elector of Mentz in 1788; envoy to Paris in 1792. Published *History and Description of the Breadfruit* (1784); *Views of the Lower Rhine, Brabant, Flanders, etc.* (3 vols., 1791), etc. A collection of his letters was published by his widow (2 vols., 1829), and a complete edition of his works was published in 1843. He made a translation of the *Sakuntâlâ* into German, was the tutor of Humboldt, and one of the fathers of modern German literature. D. in Paris, Jan. 11, 1794.

Forster, JOHANN REINHOLD: traveler and naturalist; b. at Dirschau, Germany, Oct. 22, 1729; studied theology at Halle and Dantzic; became pastor at Rassenhuben, near Dantzic, devoting his leisure time to scientific studies. In 1766 he went to England, and for two years was teacher of natural history at Warrington, in Lancashire; in 1772 accompanied Cook on his second voyage, as naturalist, and on his return published *Observations made During a Voyage Round the World* (London, 1778). In 1775 the University of Oxford conferred upon him the degree of LL. D. In 1780 he was appointed Professor of Natural History at Halle. Other works were *Introduction into Mineralogy* (London, 1768); *Flora Americæ septentrionalis* (London, 1771); *Zoölogiæ Rarioris specilegium* (Halle, 1781); with his son Johann Georg and Sprengel, *Treatise on Ethnology and Geography* (Leipzig, 1781–83). D. at Halle, Dec. 9, 1798.

Forster, JOHN: author, editor, and critic; b. at Newcastle, England, Apr. 2, 1812; educated for the bar, but devoted himself to literature, contributing to the London *Examiner*, of which he was editor for ten years; to the *Edinburgh* and *Quarterly Reviews, The Foreign Quarterly Review*, of which he was editor, etc. He also edited the London *Daily News* for a year. From 1855 to 1861 was secretary to the lunacy commission, and from 1861 to 1872 a commissioner in lunacy. His works were *Statesmen of the Commonwealth of England* (1831–34); *Life of Oliver Goldsmith* (1848); *Biographical and Historical Essays* (1859); *Arrest of the Five Members by Charles I.*, and *Debate on the Grand Remonstrance* (1860); *Sir John Eliot, a Biography* (1864); *Walter Savage Landor, a Biography* (2 vols., 1868); *Life of Charles Dickens* (vol. i. in 1871; vol. iii. in 1874); *Life of Dean Swift* (vol. i., 1876). D. in London, Feb. 1, 1876.

Forster, WILLIAM: philanthropist; b. at Tottenham, near London, England, Mar. 23, 1784; became a minister of the Society of Friends in 1803; married Anna, sister of Thomas Fowell Buxton, in 1816. In 1820 visited the U. S.; in 1838 settled as a preacher near Norwich, England; in 1844–45 labored as such in France; in 1846 traveled in Ireland to relieve the distresses there caused by famine. Commissioned in 1849, by the London Yearly Meeting, to present an address on slavery and the slave-trade to rulers in Christendom, he had interviews with European monarchs, and in 1853 with the President of the U. S. and several Governors of Southern States. D. on the Holston river, Blount co., Tenn., Jan. 27, 1854.

Forster, Rt. Hon. WILLIAM EDWARD: English Liberal statesman and orator; b. at Bradpole, Dorset, July 11, 1819; educated at the Friends' School, Tottenham, and was a worsted manufacturer at Bradford. As a Liberal he unsuccessfully contested Leeds in 1859, but was returned to the House of Commons Feb., 1861, for Bradford, and was member of Parliament till his death. Was Under-Secretary for the Colonies in Lord John Russell's administration from Nov., 1865, until July, 1866, and vice-president of the committee of council on education in 1868. Mr. Forster was magistrate and deputy lieutenant for the West Riding of Yorkshire. He had much to do with passing through the House of Commons the Education Bill in 1870 and the Ballot Bill in 1871, and was a strong supporter of the imperial federation scheme. Mr. Forster was a son-in-law of Dr. Arnold of Rugby. In 1874 he visited the U. S. In 1875 he was elected lord rector of Aberdeen University. He was Chief Secretary for Ireland 1880–82. D. in London, Apr. 5, 1886. See *Life* by Wemyss Reid (1888).

Forsyth, JOHN: statesman; b. at Fredericksburg, Va., Oct. 22, 1780; graduated at Princeton in 1799. His father, a Revolutionary soldier of English birth, removed to South Carolina, and thence to Augusta, Ga. John became a distinguished lawyer; was attorney-general of Georgia in 1808; was in Congress 1813–18 and in 1823–27; U. S. Senator 1818–19 and 1829–37; Governor of Georgia 1827–29. U. S. minister to Spain 1819–22; U. S. Secretary of State 1835–41. Forsyth made an able Secretary of State, but his attitude toward Mexico in the complications resulting from the Texan war of independence and his known sympathy with the project of annexing Texas gave rise to much adverse criticism, especially among anti-slavery writers. D. at Washington, D. C., Oct. 21, 1841.

Forsyth, WILLIAM, Q. C., LL. D.: barrister; b. at Greenock, Scotland, in 1812; educated at Trinity College, Cambridge (B. A. 1834, M. A. 1837); called to the bar at the Inner Temple in 1839, and became in 1857 queen's counsel, and bencher of the Inner Temple in 1859. He was standing counsel to the Secretary of State in council for India 1859–74, and M. P. for Marylebone 1874–80. Among his works are *On the Law of Composition with Creditors* (1841); *Hortensius, or the Duty and Office of an Advocate* (1849); *On the Law Relating to the Custody of Infants* (1850); *The History of Trial by Jury* (1852); *Napoleon at St. Helena, and Sir Hudson Lowe* (1853); *Life of Cicero* (1864); *Cases and Opinions in Constitutional Law* (1869); *The Novels and Novelists of the Eighteenth Century* (1871); *Hannibal in Italy, an Historical Drama* (1872); *Essays, Critical and Narrative* (1874); *The Slavonic Provinces South of the Danube* (1876).

Forsythia, fōr-sī'thi-a [named in honor of William Forsyth (1737–1804), a Scotch gardener and pomologist]: a genus of shrubs of the order *Oleaceæ*. The *F. viridissima* and *F. suspensa*, small Chinese shrubs, very common in cultivation, are very hardy, and conspicuous for their yellow flowers which appear in early spring before the leaves.

Fort: a fortification, usually inclosed and provided with flanking arrangements and accessory means of defense, which generally are lacking in the smaller works known as REDOUBTS (*q. v.*). In the U. S. the military posts of the interior are known as forts, although generally without fortifications of any kind. For further information as to FORTIFICATIONS, see that title. JAMES MERCUR.

Fort Adams: a fortification constructed on Brenton's Point, entrance to Newport harbor, R. I. This work, planned and built 1828–38 by Gen. Joseph G. Totten, subsequently chief engineer U. S. army, is one of the few works of the system of seacoast defense in the U. S. designed to sustain a regular siege. Its land fronts are elaborately arranged according to the principles of the art as then received.

Fortaleza, fōr-tāā-lā'zāā (often, but incorrectly called CEARÁ): a city of Northeastern Brazil; capital of the state of Ceará; on the Atlantic Ocean, in lat. 3° 42′ S. (see map of South America, ref. 3–H). The coast at this point forms a slight bay, but the shores are exposed to heavy surf, and vessels anchor 2 miles out in an open roadstead; passengers and freight to and from the land are generally carried on *jangadas* or sailing-rafts. The town, built on a low bluff, is regularly laid out, and the principal streets are lined by substantial buildings, but with little architectural display. The heat is modified by sea-breezes, especially during the dry season, and the town is generally healthy, though it has been visited by several severe epidemics of yellow fever and smallpox. The country immediately back is a barren waste of sand and scrub; a railroad, extending inland to Baturité, connects the port with the rich grazing and agricultural districts of the interior. Fortaleza is the principal port of Ceará, and has a large trade, exporting sugar, hides, rubber, etc. The name, meaning a fortress, is derived from the old fort of Amparo, built here in 1611. Pop. (1893) about 20,000. HERBERT H. SMITH.

Fort Atkinson: city; Jefferson co., Wis. (for location of county, see map of Wisconsin, ref. 7–E); on railway and on Rock river, near Lake Koshkonong; 24 miles N. N. E. of Janesville. It contains a large manufactory of furniture, wagons, buggies, and cutters, two foundries, an extensive manufactory of dairy, creamery, and cheese-factory apparatus, and manufactures of harrows, brooms, and wheelbarrows, and has a national bank with $60,000 capital. Pop. (1880) 1,969; (1890) 2,283; (1900) 3,043.
EDITOR OF "JEFFERSON COUNTY UNION."

Fort Barrancas: a small work in Florida, on the north side of Pensacola Bay. In 1861 this fort was garrisoned by a small body of artillery under command of Maj. Adam Slemmer. When, in Jan., 1861, Com. Armstrong of the navy surrendered the navy-yard to the Confederates, Maj. Slemmer abandoned this work and transferred his command to the more important work, Fort Pickens, on Santa Rosa island, opposite. Barrancas was held by the Confederates until the evacuation by them of Pensacola.

Fort Bowyer: See FORT MORGAN.

Fort Brady: a military post (occupied by two companies) at Sault Ste. Marie, Mich. It is an important military position, commanding the St. Mary's river and canal. See also ST. MARY'S RIVER.

Fort Brown: a military post at Brownsville, Cameron co., Texas; half a mile from the site of the old Texan Fort Brown (for location of county, see map of Texas, ref. 8–H). It has quarters for a regiment, but, the place being unhealthful, the garrison is usually small. On the other side of the Rio Grande is the Mexican town of Matamoras.

Fort Canby: one of the defenses of the mouth of the Columbia river; situated on Cape Hancock or Disappointment, Pacific co., Washington (for location of county, see map of Washington, ref. 4–A). The fortifications are on a bluff about 200 feet high, the quarters near the water.

Fort Chipewayan: See the Appendix.

Fort Churchill: See the Appendix.

Fort Collins: town and railway junction; capital of Larimer co., Col. (for location of county, see map of Colorado, ref. 1–D); on the Cache la Poudre river; 70 miles N. of Denver. It has excellent water-power and some manufactures, and is the site of the Colorado Agricultural College. Principal business, agriculture, dairying, and stock-raising. Pop. (1890) 2,011; (1900) 3,054.

Fort Covington: village; Franklin co., N. Y. (for location of county, see map of New York, ref. 1–I); 15 miles N. W. of Malone; on railway and the navigable Salmon river, 5 miles from its mouth and a mile from the Canada line. It has an academy; dairying and farming are the leading interests. Fort Covington is memorable for the sufferings which the U. S. army endured at this point during the winter of 1813–14. Pop. (1890) 870; (1900) 822.

Fort de France (Fr. pron. fōr'de-fraañs'), formerly FORT ROYAL: capital of Martinique, French West Indies; on low, flat land bordering Port Royal Bay, near the southern end of the island (see map of West Indies, ref. 7–M). It was formerly the principal port, but has been supplanted by St. Pierre. The bay is defended by Fort St. Louis, an important post during the French and English wars. The city is regularly laid out, with substantial houses, generally of wood, and the surroundings are exceedingly picturesque. There is a small park containing a monument to the Empress Josephine, who was born near the place. Pop. (1892) about 15,000. HERBERT H. SMITH.

Fort Dodge: city; capital of Webster co., Ia. (for location, see map of Iowa, ref. 4–F); situated on Des Moines river, the Chi., R. I. and Pac., Ill. Cent., Mason City and Fort D., and Minn. and St. Louis R. Rs.; 90 miles N. of Des Moines. It has a college, a large graded school with excellent ward schools, a Catholic seminary, fine quarries of building-stone, large deposits of gypsum, coal, fire-clay, potter's clay, and water-lime, various manufactures, one of the largest oat-meal-mills in the State, gas-works, electric lights, and water-works. Pop. (1880) 3,586; (1890) 4,871; (1900) 12,162.
PUBLISHERS OF "CHRONICLE."

Fort Donelson: See FORT HENRY AND FORT DONELSON.

Fort Duquesne: See PITTSBURG.

Fort Edward: village; Washington co., N. Y. (for location of county, see map of New York, ref. 4–K); on railway and on the east bank of Hudson river; 28 miles N. of Troy. A dam 900 feet long and 27 feet high crosses the Hudson, and affords great water-power. The village is finely situated, has a seminary and collegiate institute, and extensive manufactures, including iron, lumber, machinery, and stoneware. The first fortification here was built in 1709; another and larger one called Fort Lyman was built in 1755, but the present name was soon substituted in honor of Edward, Duke of York. Some remnants of the fort still remain. Fort Edward was a point of importance during the old French and Indian wars, and during the Revolution was occupied in turn by British and Americans. Pop. (1880) 2,988; (1900) not separately returned.

Fort Erie: post-village of Welland co., Ontario, Canada (for location of county, see map of Ontario, ref. 5–E); on two railways and on Lake Erie, at the head of the Niagara river opposite Buffalo, N. Y., with which it is connected by a railway bridge. Pop. 1,000.

Fort Ethan Allen: a military post established in Mar., 1893; situated near Essex Junction, Vt., about 5 miles E. of Burlington (for location, see map of Vermont, ref. 4–B). It is designed for the accommodation of a large garrison, and to form one of the cordon of posts along the northern frontier of the U. S. JAMES MERCUR.

For'tescue, CHICHESTER SAMUEL PARKINSON: See PARKINSON-FORTESCUE, CHICHESTER SAMUEL.

Fortescue, Rt. Hon. HUGH, Earl: English statesman and author; b. Apr. 4, 1818; educated at Harrow and Trinity College, Cambridge; entered Parliament in 1841; in Dec., 1854, was chosen for Marylebone; resigned and was called to the upper house for his father's barony of Fortescue Dec. 5, 1859, succeeding as third earl Sept. 14, 1861. In 1846–47 was a Lord of the Treasury, secretary of the poor law board 1847–51, besides being chairman of several successive metropolitan commissions of sewers. Retired from Parliament after 1858 in consequence of ophthalmia, contracted in visiting a hospital with a view to his successful parliamentary motion for sanitary reform. He has written *The Health of Towns* (1844); *Official Salaries* (1852); *Representative Self-government for the Metropolis* (1854); *Parliamentary Reform* (1859); *Public Schools for the Middle Classes* (1864).

Fortescue, Sir JOHN: English chief justice of the king's bench; b. probably about 1395; became sergeant-at-law 1429; one of the king's sergeants in Easter 1441; chief justice Jan. 25, 1442, to Easter 1460; escaped with Henry VI. into Scotland at the end of Mar., 1461; was attainted of high treason 1463; escaped with Queen Margaret to the Continent; was pardoned by Edward IV. Oct., 1473, and was living in Feb., 1476. Wrote *On the Praises of the British Laws*, in Latin, between 1461 and 1470, a masterly exposition of English law, and *The Governance of England*, otherwise called *The Difference between an Absolute and Lim-*

ited Monarchy, as it more particularly regards the English Constitution (1714; new ed., Clarendon Press, 1886).

Fort Fisher: a strong earthwork on Federal Point, N. C., between the ocean and the Cape Fear river; erected by the Confederates during the civil war to guard the mouth of the river. It consisted of two faces. The general direction of the land face, running N. W. and S. E., was nearly perpendicular to the beach and the shore of the river, separated at this point about half a mile. It was between 500 and 600 yards long, and was designed to resist an attack by a force landing on the beach to the north and marching against it. The sea face, nearly perpendicular to the land face, was about 1,400 to 1,500 yards long. It ran N. E. and S. W., parallel to the beach, and terminated at its southwestern extremity in a battery 60 feet high, mounting two heavy guns, called the "mound battery." The land face mounted 20 heavy guns and 3 mortars, with 3 Napoleon guns for guarding the gate near its center and the road bridge at the left flank of the work. To protect the guns from enfilade and reverse fire from the fleet, they were placed singly between long, thick, and high traverses, except at the left flank, where a change in the direction of the parapet allowed one traverse to cover two guns. The ground in front of this face was also defended by land torpedoes electrically connected with the fort. A strong palisade extended along the foot of the parapet to and around the salient of the work. On the sea face were mounted twenty-four heavy guns, also well protected with traverses and provided with bomb-proof magazines and shelters for the men. All the guns of the fort were mounted *en barbette.* Near the extremity of Federal Point was a wharf for deep-draught vessels, and not far from this Fort Buchanan, an elliptical fort mounting four guns covering the inlet and sweeping the land approaches. The blockade-runners entering the Cape Fear river finally became almost the only source from which supplies not manufactured in the Confederacy could be obtained, and to cut off these supplies it was necessary to capture Fort Fisher. A combined land and naval attack was therefore planned and carried out on Dec. 23, 24, and 25, with Gen. B. F. Butler in command of the land forces and Admiral Porter in command of the fleet, but they were obliged to retire without effecting serious damage upon the fort. An attempt to blow up the fort by the explosion of a powder-boat was made without effect. Gen. Grant determined to renew the attempt to capture the fort, and, Jan. 4 and 5, 1865, embarked a force of about 8,000 men at Bermuda Hundred, under command of Gen. Terry, making Beaufort the rendezvous as before, and reached this place on Jan. 8. On the evening of the 12th the fleet and transports were again before Fort Fisher, and on the morning of the 13th the debarkation commenced, while the bombardment of the fort was begun by the ironclads. The troops having all landed in the afternoon, the whole fleet joined in the bombardment, which was mainly directed upon the land face. The firing during the night of the 13th was kept up by the ironclads, and during the night and day of the 14th was continued with a view to keeping down the fire of the fort and dismounting the guns on the land face. Meanwhile the land forces had thrown up a line of works across the peninsula to guard against an attack from any relieving force, and arrangements were made for a simultaneous assault at 3 P. M. of the 15th by the army and a column of marines and sailors from the fleet. In the morning fire was opened by the entire fleet, and continued until the assault was made. At about noon the sailors and marines began to land, and at 3 P. M., upon signal, they and the land forces made the assault, the sailors attacking the salient and the army the left flank of the land front. The naval attack was repulsed with great loss. The army captured the extremity of the line, and fighting its way from traverse to traverse, assisted by the fire of the ships when it could be so directed as not to injure the Union troops, by 10 P. M. had occupied the entire work and received the surrender of the garrison. The effective strength of the army in the attack of the 15th was about 8,000 men. The losses in killed, wounded, and missing were about 1,000. The naval assaulting column contained about 2,000 men and lost about 300. The total Confederate force was from 2,000 to 2,500 men, of whom about 500 were killed or wounded and the remainder captured. On the morning of the 16th an explosion of the main reserve powder magazine occurred, killing and wounding about 100 Union troops and a number of Confederates. This explosion seems to have been accidental, although at the time it was supposed that the Confederates fired the magazine by electricity from the other side of the river. JAMES MERCUR.

Fort Foote: an inclosed barbette work with exterior batteries; situated on the Potomac river, 6 miles below Washington; on a commanding bluff of the Maryland shore, 100 feet above the river. It was constructed during the civil war, and forms the inner line of defense of the channel of approach by water to Alexandria and Washington.

Fort Gaines: town; capital of Clay co., Ga. (for location of county, see map of Georgia, ref. 6–F); on railway, and on the navigable Chattahoochee river. It has a commanding position, and a good trade in cotton. There are numerous ancient artificial mounds in the vicinity. Pop. (1880) 867; (1890) 1,097; (1900) 1,305.

Fort George: a fortification in Inverness-shire, Scotland; on a spit of land jutting out into the Firth of Moray. It was built in 1748 to keep the Highlanders in subjection.

Fort Gratiot, -grăsh'i-ot: city; St. Clair co., Mich. (for location of county, see map of Michigan, ref. 7–K); now part of Port Huron; at the outlet of Lake Huron; opposite Point Edward, Ontario, Canada. It has railway machine-shops. Pop. (1880) 1,280; (1890) 2,832.

Fort Griswold: See NEW LONDON, Conn.

Forth: a river of Scotland; rises in two branches, the Avendhu and the Duchray, which unite at Aberfoyle. It then passes, with many windings, through the most picturesque and romantic part of Scotland, by Stirling, and a little above Alloa it empties into the Firth of Forth. It is navigable for vessels of 100 tons to Stirling, and to Alloa for vessels of 300 tons. It communicates with the Clyde by a canal 38 miles long. The depth increases between Grangemouth and North Queensferry in the first mile from 10 to 15 feet; in the second, to 25; in the third, to 53; and the remaining part of the distance has a general depth of 60 feet at low water. The tides are felt 4½ miles above Stirling, and at Stirling harbor the spring tide rises 7 ft. 9 in. At Leith and Kinghorn the average height of the tide is 17½ feet. The bed of the river consists, to a great extent, of mud, the depth of the deposit being in some places more than 200 feet, and there are extensive alluvial formations along the lower course of the river and in the upper parts of the estuary. The fisheries of herring, whitefish, and salmon are very important. In 1889 a great railway bridge, one of the most remarkable in the world, was erected across the Forth at Queensferry. See BRIDGES.

Fort Hamilton: a fort on the eastern shore of the Narrows, the principal entrance to New York harbor.

Fort Hancock: one of the strongest forts in the U. S.; on Sandy Hook, N. J. (see map of New Jersey, ref. 3–E); designed to control the entrance to the lower New York Bay. Attached to the fort are grounds used in testing guns, armor, projectiles, etc.

Fort Henry and Fort Donelson: two works erected by the Confederates during the civil war in the U. S.; the former on the right bank of the Tennessee river, the latter on the left bank of the Cumberland river, about 40 miles from where these rivers empty into the Ohio; distant from each other about 12 miles, and connected by a direct road. A combined land and naval attack for the reduction of these works having been determined upon, the naval force was intrusted to Com. Andrew H. Foote, and the land force, numbering about 15,000, assigned to Brig.-Gen. U. S. Grant. On Feb. 2, 1862, the naval fleet left Cairo, followed by the troops in transports, arriving on the 4th off Fort Henry, where it had been resolved to make the first attempt. This fort was defended by 17 guns and about 3,000 men, under the command of Brig.-Gen. Tilghman. After landing the troops and making reconnoissances, the morning of Feb. 6 was settled upon for the combined attack, which was accordingly commenced at noon by the navy, the army having started an hour earlier with the expectation of cutting off the retreat should the fire of the navy compel the enemy to abandon the position; but Com. Foote attacked with such vigor as to compel the surrender of the work in but little more than one hour, while the army, being delayed by the condition of the roads, did not arrive till some time later; the Confederate garrison meanwhile escaping to Fort Donelson, with the exception of about sixty or seventy men, besides Gen. Tilghman and his staff, who surrendered with the work. After waiting a sufficient time to repair the damage sustained by the gunboats, Gen. Grant on the 12th moved with his army toward Fort Donelson, arriving before that work the same afternoon. In the meantime the garrison at Fort Donelson, consisting mainly of those who had escaped from Fort Henry, had been re-enforced on the 9th by the command of Gen. Pillow, and on the 12th by that of Gen. Buckner from Bowling Green, and on the following day by the brigade of Gen. John B. Floyd, who, being the senior officer, assumed command of the entire force of about 16,000 men. This work, while it commanded well the river-front, was in the rear commanded by high ground, which was, however, secured and fortified before the arrival of the Union forces. Gen. Grant at once proceeded to invest the Confederate lines, and early on the morning of the 13th opened a vigorous cannonade, followed in the afternoon by an assault by a part of McClernand's force, which was, however, repulsed with considerable loss. On the 14th re-enforcements to the number of 10,000 reached Grant, bringing his land forces up to about 27,000 men, together with the fleet of Com. Foote, and a combined attack was determined upon. Being unable to get the new troops in position, the fleet opened the attack alone in the afternoon, but after an hour and a half, during which time every gunboat was disabled and 54 men killed and wounded, the fleet was compelled to retire. Gen. Grant now proceeded to complete his line of investment and await the re-enforcement of his army. The Confederate commanders, however, realizing their danger, had agreed upon a vigorous attack, by which it was hoped to secure an avenue of retreat to Nashville, which, intended as a surprise, was commenced at 5 A. M. on the 15th, but was met by a fire from the Federal force, and a battle ensued with varying success until about 3 P. M., when a final advance was ordered by Gen. Grant along the whole line, which drove the Confederates back to their own lines, while on the left a position was gained within the Confederate works. The loss on each side during this day's conflict was, in killed and wounded, nearly 2,000. Gen. Grant now made his preparations for a general attack the next morning, which, however, was not executed, for during the night the Confederate commanders, finding the Union line of investment completely restored, had determined upon a surrender. Pillow refused to consent to a capitulation, while Floyd acknowledged that "personal reasons" prevented him from acceding to such a decision, thus devolving the surrender upon Buckner. During the night Floyd managed to escape by steamers with some 1,500 of his own command, as did Pillow and his staff, also Gen. Forrest with 300 or 400 men, by the river-road. At dawn of the 16th Buckner addressed a communication to Gen. Grant, asking the appointment of commissioners to settle upon terms of capitulation and an armistice until noon, to which Grant sent his famous reply: "No terms except unconditional and immediate surrender can be accepted. I propose to move immediately upon your works." Buckner, having no alternative, accepted these terms. No exact statement of the captures can be given; the most reliable estimates place them at 65 cannon, about 17,000 small-arms, and about 14,000 prisoners, many of whom were wounded. The total Union loss in killed, wounded, and missing was 2,832.

Revised by JAMES MERCUR.

Fort Howard: city and railway center; Brown co., Wis. (for location of county, see map of Wisconsin, ref. 5–F); on the west side of Fox river, near its mouth, opposite the city of Green Bay; 114 miles N. of Milwaukee. It has 9 churches, 5 brick school-buildings (including a large high school), numerous and extensive lumber-manufactories, the G. B., W. and St. P., and the Ch., M. and St. P. Railway machine-shops, sash, door, and blind factories, canning-factories, brick-yards, machine-shops and boiler-works, electric lights, sewers, water-works, etc., a fine harbor, and an extensive trade. Pop. (1880) 3,083; (1890) 4,754. Now a part of Green Bay.

EDITORS OF "REVIEW."

Fortification [from Fr. *fortification* : Ital. *fortificazione* < Low Lat. *fortifica'tio*, deriv. of Lat. *fortifica're*, make strong, fortify; *for'tis*, strong + *fa'cere*, make]: the art of rendering a military position defensible against the attacks of superior numbers; also the work or works erected for this purpose. The art of fortification is usually divided into two branches—permanent fortification and field or temporary fortification. Permanent fortifications are constructed to defend a position of permanent importance, and are made of durable materials. Field fortifications are intended to serve a temporary purpose, and the materials employed are those found most ready at hand. The principles of the art are essentially the same in both. Permanent fortifications being the more elaborate, it will be convenient, in a brief exposition of the subject, to consider that branch first. It will be necessary to assume that the reader is acquainted with the elementary terms employed.

I. PERMANENT FORTIFICATION.

General Definitions.—A modern fortress usually consists of an inclosure of earth and masonry, called the enceinte, or body of the place, secured by a citadel within, and strengthened by works on the exterior, called outworks.

The mass of earth employed to cover the bodies of the defenders while in action from the enemy's projectiles is called the parapet. It is raised upon another mass of earth called the rampart, R (Fig. 1).

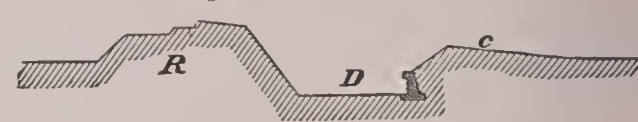


FIG. 1.

Outside the rampart is the ditch, *D*, which is made deep and wide enough to offer a serious obstacle to the enemy; and beyond the ditch the glacis, *c*.

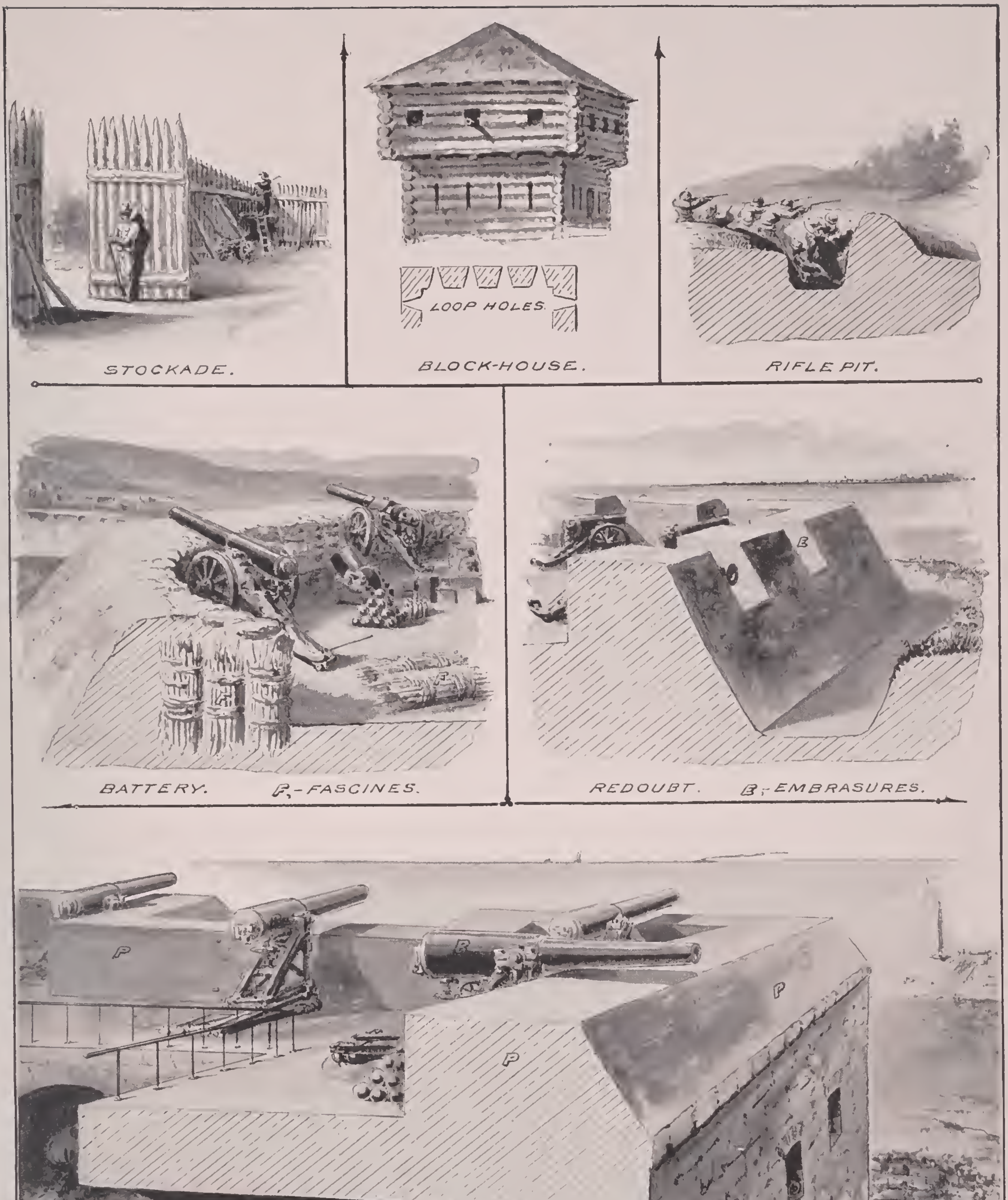
If the plan, or trace, of the enceinte should have the form of a simple polygon with only salient angles, the ditch would not be under the fire of the work, and an enemy having reached it would there find shelter. The arrangements by which the exterior slope and bottom of the ditch are brought under fire are called flanking arrangements. In general terms, they consist in arranging the sides of the polygon so as to make both re-entrant and salient angles. In small works, having only salients, galleries are sometimes built behind the counterscarp, having a fire upon the ditch. When the flanking arrangements are imperfect, the space left unexposed to the fire of the work is called a dead space.

Systems of Fortification.—The main points to be attained in any fortification are—1, to offer an obstacle to the advance of the enemy to a hand-to-hand conflict; 2, to cover the defenders from his projectiles; and 3, to thoroughly sweep with its fire all the ground within range on the exterior, including its own ditches. A vast number of different methods of securing the above ends have been proposed. There are three principal systems, however, which these methods approach more or less closely, and which will alone be noticed. These are the tenailled (Fig. 2), the bastioned (Fig. 3), and the polygonal systems (Fig. 4). The figures represent the systems on a perfectly horizontal site, where there is nothing to cause irregularity. To avoid unnecessarily complicating the figures, only the magistrals, interior crests, rear lines of terrepleins, and foot of rampart slopes are shown. The heavy black lines are the interior crests; the stippled portions are the bottoms of the ditches. In Fig. 2 only the magistral and interior crest of the enceinte are shown.

It will be observed that the lines are straight in all of them. To make them curved would either scatter their fire or concentrate it upon a single point, since the direction of the line of fire is always assumed to be perpendicular to the interior crest, this being the most natural direction for the soldier to fire in, and the one which he will always employ at night. Moreover, if the lines were curved, it would not be possible to flank them, since the path of the projectile is a straight line.

Before describing these systems it should be noticed that the mere inclosing a given space by a rampart of the usual height will not necessarily of itself afford the required cover to the defenders. If the direction given to the lines is such that the enemy can place himself upon the prolongation of them, he can land his projectiles at one end of the terreplein and sweep it to the other; fire striking a line in such a direction is called enfilade fire. Should the enemy be able to take up a position from which he can fire over one portion of the inclosure, and strike in rear the parapet beyond, the latter is said to be exposed to reverse fire. Lines placed so as to be exposed to enfilade or reverse fires are faulty; and though it is not always possible to avoid so placing them, on account of the necessity of giving their fire a suitable direction, it is evident in comparing the different systems that the one which will least often require this fault will, so far, be the best.

Tenailled System.—The tenailled trace is shown in



FORTIFICATIONS.

Fig. 2. This trace is simple, adapts itself well to irregular ground, and provides a cross-fire upon the approaches. At first glance it seems to be well flanked, but that is not the case. The greatest angle of depression at which artillery is fired is about 1 upon 6. Supposing the height of the gun

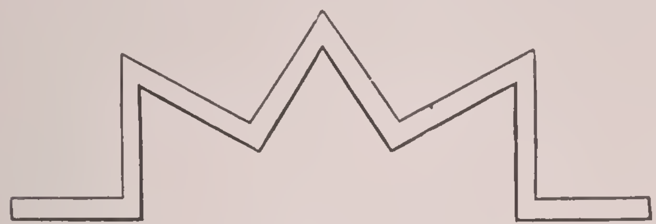


Fig. 2.—Tenailled system.

to be 40 feet above the bottom of the ditch, it can not strike this bottom at a distance less than 240 feet. Hence there is a considerable dead space at each of the re-entrant angles. For the same length of parapet this trace incloses less space than either of the other traces. The great number and the sharpness of its salients render its faces peculiarly liable to enfilade and reverse fires.

Bastioned System.—Fig. 3 shows the bastioned trace. It will be observed that the great distance between the flanks and the opposite glacis will expose the masonry scarp of the former to the curved fire of the enemy. To partially remedy this defect, and to cover the masonry of the curtain, the tenaille, *T*, was introduced. It is a low outwork, so constructed as not to interfere with the fire of the flanks upon the ditch in front of the bastion faces, and is armed with musketry. It creates, however, a considerable dead space.

In the attack of this enceinte the enemy would make his approaches along the capital of the bastion, and the greater portion of the fire which can be brought to bear in this di-

Fig. 3.—Bastioned system.

rection is comparatively distant, since it comes from the adjacent bastions. This weak point is strengthened by the construction of the demilune, *D*. Two adjacent demilunes throw the bastion between them into a strong re-entrant, and add enormously to the strength of the front. The demilune serves also to mask the shoulder angles of the bastion and to cover the communications under the curtain.

In the employment of the bastioned system it would be very difficult to so place all of the lines that none would be exposed to enfilade and reverse fires. The connection be-

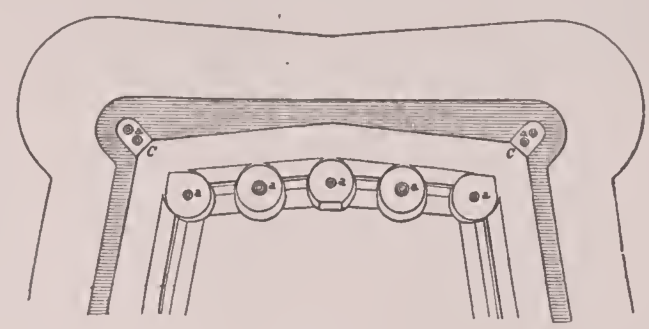


Fig. 4.

tween its parts is so rigid that it is best adapted to a flat country, such as Holland, where, in a modified form it was largely used at the close of the seventeenth century; in very rough sites it is entirely inapplicable. The flanks being situated at a considerable distance from the faces to be flanked, a portion of the range of their guns is lost. The height of the parapet is limited by its length of front.

Polygonal System.—In this system the faces are but little exposed to enfilade or reverse fires, since the enemy in placing himself upon the prolongation of one of them, will place himself within short range of the adjacent ones; and it is easy to cover these prolongations by adjacent outworks. For the same length of parapet more ground is inclosed than in either of the other systems. The length of a front —or what amounts to the same thing, of the lines of defense —may be greater than in the bastioned, since the full range of the flanking guns is made available. This system adapts itself better to irregular sites.

Each of these systems has had its partisans. The contest between those of the bastioned and those of the polygonal has been especially sharp, and has resulted in the adoption of the polygonal system by all great nations. The other systems are mainly of interest on account of existing fortifications, built prior to the modern development of firearms, though they may find occasional application in places not greatly exposed, as in the gorge of an inclosed work.

Principles of Fortification.—The more important fundamental principles in all systems are—

1. They must have good flanking arrangements.

2. The lines of defense must be as long as possible, supposing the dimensions of the fortress to permit it, in order to avoid short fronts and a multitude of flanks. Their length is limited by the range of the weapons used for flanking; and these weapons must be such as will throw a large number of projectiles heavy enough to disable men. Rifled artillery is not suitable; machine-guns and howitzers are generally used. The how-

itzer is used for occasionally throwing shells to destroy any temporary cover the enemy may erect.

3. The enceinte must have a considerable command over the surrounding country and over the outworks. The height of the interior crest is limited by the necessity of thoroughly sweeping the ground on the exterior, and of not offering too great an object to the direct fire of the enemy. It is rarely more than 25 or 30 feet above the natural surface of the ground.

4. Masonry is not to be exposed to the fire of the enemy. In seacoast fortification it is frequently necessary to concentrate a large number of guns upon a confined space, and they are placed in tiers of casemates, one over the other. These works being subject only to fire from ships, the masonry was exposed with comparative impunity, since this fire is so unsteady as not readily to strike the same spot many times in succession. But a single shot from the powerful artillery now in use will do as much execution as a series of the old ones. Hence it becomes necessary to substitute iron or steel for masonry where earth can not be employed. When practicable the guns are placed in cupolas, with roof of spherical form (a, a, a, Fig. 4). or mounted on disappearing carriages. A cupola is a hollow revolving structure of steel or iron, containing one or two guns, buried in a mass of concrete, which in turn is buried in the parapet.

5. The nearer the general direction of the fronts fortified shall be to a straight line the better, since thus a large amount of fire can be concentrated upon the approaches.

6. The arrangement of the works must be such that, as far as possible, the prolongations of the parapets shall not be attainable by the enemy, and the terrepleins be covered against vertical fire. The first is secured by a proper placing of the lines, and the second by casemates and bombproofs.

7. The outworks must be so arranged that their capture must necessarily be successive, thus introducing the element of time into the defense. If two outworks can be attacked simultaneously, their capture may require more material, but not more time, than if there were only one.

8. All parts of a fortification should be equally strong. Hence if one part is the stronger by nature, the others will demand more from art. This sometimes leads to the multiplication of works upon one or more of the fronts.

Accessory Defenses.—The advance of an enemy is very seriously retarded by a judicious use of countermines. In addition to the works exterior to the enceinte, works are sometimes constructed within it, called the reduit, the object of which is to defend the breach when made, and to furnish the garrison a point of retreat whence the defense may be prolonged.

When the face of a work is exposed to enfilade fire, the destructive effects of the latter may be much diminished by raising masses of earth at intervals along the terreplein. These masses are called traverses (y, y, y, Fig. 3); they extend across the terreplein in a direction nearly perpendicular to the interior crest. When a parapet is exposed to reverse fire, a mass of earth is thrown up behind it and its defenders; this mass is called a parados. Both the parados and traverse may be utilized for the purpose of bombproofs, magazines, and cupolas. They are both essential to limit the action of the modern explosive projectile.

It is of great importance to remove all obstacles which could afford cover to the enemy anywhere within range of the guns. Forests and buildings are cleared away, and inequalities of the ground graded off.

Economy of Fortification.—In determining upon the amount of money that can be assigned to the construction of fortifications, the latter should be regarded as so much insurance, and insurance not only against pecuniary loss, but also against national dishonor. Their extent at any given point must therefore depend upon the importance of the point and the risk of its capture. Among a warlike people the risk of capture will be less when the population is dense and re-enforcements in materials and men can readily be procured. Hence an isolated point, with but a sparse population in its vicinity, will require the maximum percentage of its value for fortification, supposing always that the facilities for attack are the same, and that the site offers no great natural advantages to the defense. The points of greatest value with a nation having powerful neighbors are the great strategic pivots, the occupation of which by an enemy would endanger the life of the nation; such are, in Europe, the capital and great commercial centers. A very small percentage of their value will give very large sums for their defense, and European nations expend these sums without hesitation.

The size of the works is not always an indication of their strength, nor is their cost always proportionate to the value of the point defended, though their strength must be. Everything varies with the locality.

Permanent Fortifications in the U. S.—The frontiers which are exposed to attack being principally maritime, the fortifications of the U. S. consist almost entirely of batteries of heavy guns adapted to a contest with ships. To secure these batteries from a land attack, they are inclosed in rear by a land-front, traced according to the principles above laid down, and made strong enough to hold an enemy in check until re-enforcements can arrive. These land-fronts are seldom designed* to resist a regular siege for a great length of time, it being assumed that the vast resources in men and material that are available, and the system of railroad and water communication, will enable a superior force to be brought to meet an enemy at any point, provided time is allowed to assemble them; it is to gain this time that the land-fronts are constructed.

The essential feature of these works is the sea-front. Where space is available the guns are spread out in a single tier.

Where the space is contracted it has been usual to mount guns in masonry casemates built tier over tier. Some of the works in the U. S. built prior to 1860 have three tiers of casemates, and a barbette battery on top. This method of building was recognized throughout the world, and was the one generally adopted in the U. S., up to the date of modern developments in the construction of guns and ships, by which the caliber, range, and power of the first were immensely increased, and almost impenetrable ironclad vessels superseded wooden ones. The method is now discarded, and the question of adapting casemates to seacoast batteries has not come to a practical solution.

The majority of the present fortifications in the U. S. belong to what is known as the third system, the first comprising those built after the breaking out of the French Revolution in 1789, and the second those built just before the war of 1812. The works of the first and second systems were small and weak. The third alone was systematically planned after a comprehensive study of the coast and northern frontier; a board of engineer and naval officers was convened for the purpose, of which the celebrated French engineer Gen. Simon Bernard and Gen. Joseph G. Totten were prominent members. It was commenced in 1816, and notwithstanding the vast extent of the coast it was until about 1865 in a very fair state of defense. This third system, founded upon broad general principles which are perennial, is now much behind the demands of the times as regards methods of construction. A new one has been planned by a mixed board of army and navy officers and civilians, presided over by Hon. William C. Endicott, Secretary of War. The report of the board was made in 1886. It proposed the use of turrets, armored casemates, barbette batteries, mortar batteries, floating batteries, and submarine mines. The estimated cost of fortifying the entire seacoast and lake frontier was $126,377,800, or less than $2 per head of population, truly an insignificant burden. The execution of this project has made a fair beginning. Good progress has been made in the preparations for manufacturing guns, securing sites, and at some of the more important points in the construction of batteries.

The scheme of defense, of which fortifications constitute one element, comprises a navy, fortifications, interior communications by land and water, and a regular army and well-organized militia. In the language of Gen. Joseph G. Totten, for many years chief of the engineer corps of the U. S. army, "The navy must be provided with suitable establishments for construction and repair, stations, harbors of rendezvous, and ports of refuge. All these must be covered by fortifications having garrisons of regular troops and militia, and be supplied with men and materials through the lines of interior communication. Not being required to remain in the harbor for their defense, the navy, pre-eminent as an offensive arm, will be prepared to transfer the war to distant oceans and to the shores of the enemy, and to act the great part which its early achievements have foretold, and to which its high destiny will lead.

* The few works—e. g. Fort Adams, Fort Monroe, etc.—which form the exception were designed and built before the year 1850, before the resources and means of inland communication of the U. S. had been developed.

"Fortifications should—1, close all important harbors against an enemy, and secure them to our military and commercial marine; 2, should deprive an enemy of all strong positions where, protected by naval superiority, he might maintain himself during the war, keeping the whole frontier in constant alarm; 3, must cover the great naval establishments from attack; 4, must protect the great cities; 5, must prevent, as far as possible, the great avenues of interior navigation from being blockaded at their entrance to the ocean; 6, must cover the coastwise and interior navigation, by closing the harbors and the several inlets which intersect the lines of interior communication, thereby further aiding the navy in protecting the navigation of the country; and 7, must shelter the smaller towns along the coast, and also all their commercial and manufacturing establishments which are of a nature to invite the enterprise or cupidity of an enemy.

"Interior communications will conduct, with certainty, the necessary supplies of all sorts to the stations, harbors of rendezvous and refuge, and the establishments of construction and repair for the use both of the fortifications and of the navy; will greatly facilitate and expedite the concentration of military force, and the transfer of troops from one point to another; will insure to these troops supplies of every description; and will preserve, unimpaired, the interchange of domestic commerce, even during periods of the most active external warfare.

"The army and militia, together with the *personnel* of the marine, constitute the vital principle of the system.

"It is important to notice the reciprocal relation of these elements of national defense: one element is scarcely more dependent on another than the whole system is to each one. Withdraw the navy, and the defense becomes merely passive; we expose ourselves the more to suffer the evils of war at the time that we deprive ourselves of all means of inflicting them. Withdraw interior communication, and the navy will often be greatly embarrassed for want of supplies, while the fortifications will be unable to offer full resistance for want of timely re-enforcements. Withdraw fortifications, and the interior communications are broken up, and the navy is left entirely without collateral aid."

It must be borne in mind that the foregoing was written when the population of the U. S. was small and the modern system of intercommunication by railroads and canals not in existence. The practical application of the principles laid down has been somewhat modified by these physical developments, but it is not the less interesting and important to understand this masterly exposition of the principles which govern the seacoast fortification of the U. S., as distinct from land fortification, which alone forms the subject of most treatises on the art.

Although it is now the settled policy of the U. S. Government to employ permanent fortifications upon the seaboard, this policy has been attacked by men in high station. A full statement of the arguments for and against it may be found in vol. iv. *Reports of Committees Second Session 37th Congress*, 1861–62.

The application of steam to vessels of war brought with it the employment of submarine mines or other obstacles as a necessary complement to seacoast fortifications. The introduction of iron plating can not impair the relative efficiency of guns in forts to those in ships, since this improvement is applicable to both, while the weight or thickness is in the fort unlimited. One of the most important applications of permanent fortifications in Europe is to intrenched camps. See INTRENCHED CAMPS.

II. FIELD FORTIFICATION.

Modification of Foregoing Principles and Rules.—In field fortifications, which are constructed during the exigencies of war, the practical application of some of the foregoing principles is somewhat modified. The parapet, instead of being raised upon a rampart, is placed upon the natural surface of the ground (Fig. 5). The ditch is no great obstacle to the advance of an enemy, and is not intended as such. It is excavated to procure earth for the parapet, and is made of the width and depth most convenient for that purpose, the scarp and counterscarp not being revetted. Some obstacle, however, is essential, as before announced, and in field works it consists of a line of obstructions placed about 50 yards in front of the ditch, *a* (Fig. 5). If possible, a second line should be established 50 yards farther to the front. The following are some of the obstacles most commonly employed: *Abatis,* formed of stout limbs of trees about 15 feet long, with the small branches cut off and the large ones pointed, laid as close together as possible, branches toward the enemy; *palisades*, or rows of stout stakes, about 10 feet long and 6 inches in diameter, planted about 3 feet

FIG. 5.

deep in the ground, about 4 inches apart, their tops being pointed and inclined to the front; *trous-de-loup*, or excavations in the form of an inverted cone, with pointed stakes at the bottom; they must be either so shallow as not to afford cover to skirmishers, or so deep that when a man has fallen into one he shall not be able to use it as a rifle-pit; *wire entanglement*, made by driving stout stakes into the ground about 7 feet apart, in three or more rows, arranged checkerwise, and connecting their tops by strong wires crossing diagonally about a foot or 18 inches above the ground; *torpedoes*. See TORPEDOES.

Inundations are sometimes made by damming back a watercourse: if the overflow is fordable, it may be rendered impracticable by digging trous-de-loup, or irregular trenches, and by scattering about harrows, boards with nails in them, or crows'-feet.

The parapet being intended primarily as a cover, and not as an obstacle, no portion of it is revetted except the interior slope, which must be made steep to enable the defenders the more conveniently to fire over it. This is effected by the use of gabions, fascines, or sods, sometimes by logs, posts, barrels, sandbags, or any conveniently improvised means.

Outworks are seldom employed in field fortification, since, even if time permitted their construction, they would obstruct the fire of the enceinte on account of its low relief.

The application of the principle that the works must have good flanking arrangements is modified in the case of field works by the fact of their low relief, which removes to a certain extent the dead spaces in front of them; and further, by the situation of the point where the enemy's advance is checked. In the case of permanent works the enemy meets his most serious obstacle when he reaches the ditch, whereas in the case of field works an enemy having once reached the ditch will, in most cases, not delay to enter the works, and the real obstacles to his advance are found 50 yards from the ditch. Hence, while it is undoubtedly desirable to have good flanking arrangements, a field work may be in an excellent state of defense without them; whereas the want of them in a permanent work would be a vital defect. Indeed, in the case of a small field work it would be injurious to the defense to break up the lines into a series of small ones, scattering the fire in several directions, and rendering it insufficient in all.

Fortifications extending over the front of the position of an army are called intrenchments or lines. Continuous lines are those which extend continuously from one end of the position to the other. Lines with intervals are those in which only the most important points are occupied by detached works, the intervals being left open.

The great development of the front occupied by an army rendered it impracticable, until a recent date, to give to all parts of a continuous line the strength necessary to resist the attacks of very superior numbers; and an enemy forcing his way through at a single point could turn the whole line. Hence in a strictly defensive position engineers preferred the line with intervals, concentrating all their means upon the detached works, and controlling the intervals by the fire of these works. The recent great improvements in the musket, particularly in loading, by means of which a thin line of troops can deliver a steady stream of fire, have changed the circumstances of the case. It has been definitely shown by many bloody experiments in the civil war in the U. S., and in the Franco-German war (1870–71), that a well-intrenched line, properly manned, can not be carried by an open assault in front. (See *Professional Papers Corps of Engineers*, No. 20, Appendix F.) The experience of these wars has also shown that troops can not be exposed for even a few moments without some cover, and that the ordinary inclosed field work of earlier days, unprovided with traverses or bomb-proofs, is of little use against the accurate and distant fire of modern weapons, while it will probably attract a concentrated fire from them. Hence result several important modifications in the application of field fortifications—viz.: 1, the employment of continuous lines of low command and easy construction for the defense of an army's front; 2, the constant use of intrenchments on the battle-field, thrown up in a few moments whenever the troops halt; and 3, the greater care in the planning and construction of inclosed works when such are employed.

The works alluded to under the first heading are called rifle-trenches, popularly known in the U. S. during the civil war as rifle-pits, which term is technically applied to another work. (See SIEGE.) Those under the second heading are used by armies something as the individual formerly employed the buckler and cuirass, and are called shelter-trenches. Rifle-trenches and shelter-trenches receive the generic name hasty intrenchments. Those under the third heading have received the appropriate name semi-permanent works.

Hasty Intrenchments.—In modern warfare the first duty of the troops upon halting after a march, when near the enemy, is to intrench themselves. During the varying tides of battle a point gained is at once intrenched. Cover for infantry is most rapidly obtained by excavating a trench about 1¼ feet deep, and throwing the earth to the front to form a parapet. This can be widened in a few minutes, so as to afford cover to men lying down (Fig. 6).

FIG. 6.

There should be ready means of getting in and out of these trenches, both to the front and rear; the troops should be able to march straight over them when necessary. At intervals of about 100 yards ramps should be formed or breaks be left in the lines, which may here overlap, to enable artillery and cavalry to pass. The trace given to these trenches is evidently the same that would be occupied by a line of battle. No attention is paid to flanking arrangements, properly so called. Should the position be long occupied, the most important points are sometimes secured by inclosed works. Should the ground be occupied for a prolonged period, the trenches are deepened and widened until they become rifle-trenches. A trench 3 feet deep and a parapet 4½ feet high, giving a total cover of 7½ feet, is the greatest vertical dimension generally given them. The natural surface of the ground forms the banquette, the parapet being thrown forward sufficiently far for that purpose. In wooded regions a revetment of the interior slope is frequently formed of logs laid one over the other. Further strength is given to the line by some of the obstacles previously described, placed about 50 yards in front.

It is natural for men lying behind breastworks exposed to fire to crouch low, and thus to raise the muzzles of their muskets while they lower the butts, and fire too high. It is therefore important to provide loopholes along the parapet, to cover the heads of those firing. A log about a foot in diameter is sometimes laid on top of the parapet, notches being cut on the lower side about 6 feet apart. Loopholes may also be made of boards or of sandbags. A screen of any kind, even if not bullet-proof, is valuable; branches of trees are therefore sometimes employed.

At suitable points the artillery is posted, the terreplein being widened and embrasures cut for the purpose. If a position can be secured where the artillery could enfilade an attacking line, it would of course be occupied, as in posting troops for battle. This is not strictly a flanking arrangement, as the term is employed in fortification.

Woods in front of the works are cleared away and ditches filled up, these clearings being extended by degrees to the full range of artillery, should the position be long enough occupied. Ditches and similar obstacles running perpendicularly to the general direction of the defenses may be left, as they will obstruct the circulation of the enemy's troops from one part of his line to the other. In long lines of rifle-trenches branches should be run back, at intervals of 500 or 600 yards, in a direction nearly perpendicular to the main line, to shut off the enemy in case of his forcing his way through, and prevent him from turning the whole line by his advantage at a single point.

The employment of inclosed works upon these hasty intrenchments is exceptional, since the labor and materials required to construct them in accordance with the demands of modern war can not usually be provided.

Semi-permanent Works.—At the breaking out of the civil war the strategic points of the U. S. were entirely unprovided with land defenses. It became necessary to construct strong fortifications, with some durability, for large cities, in a short time. These circumstances gave rise to a new kind of fortification, combining certain of the arrangements of permanent with those of field works, and called by U. S. engineers semi-permanent works. It is in this form that inclosed field works will generally be employed in the future; and these must always be employed for the land defenses of cities in the U. S. The most remarkable example of their application was in the fortification of Washington at the outbreak of the civil war. (See *Prof. Paper C. E.*, No. 20.) This city was very much exposed, was of vital importance to the Union cause, and was loosely scattered over a wide area. It was necessary not only to keep out the enemy, but to keep out his artillery projectiles, which had a range of 3 or 4 miles. The first defenses constructed were of the old field-work type, with thin parapets and steep scarps, and unprovided with bomb-proofs. They were located at the points most immediately requiring them. As some of them were laid out by the eye, the distances being measured by pacing, their weakness was recognized. As time and experience were gained, a system of great strength was developed, the defenses at the close of the war consisting of 68 inclosed forts and batteries, having an aggregate perimeter of 22,800 yards (13 miles), and emplacements for 1,120 guns, 807 of which and 98 mortars were actually mounted; of 93 unarmed batteries for field-guns, having 401 emplacements; and of 35,711 yards (20 miles) of rifle-trenches, and 3 block-houses. The permanent garrison was about 18,000, though it was expected that this would be greatly re-enforced in case of a persistent attack. The length of the line occupied was about 37 miles. "Every prominent point, at intervals of 800 or 1,000 yards, was occupied by an inclosed work; every important approach or depression of ground unseen from the forts swept by a battery of field-guns, and the whole connected by rifle-trenches." These inclosed works were the semi-permanent works; they were located upon the principles of lines with intervals, the intervals being afterward closed, as an additional precaution, by lines of rifle-trenches.

In these detached works bomb-proofs were provided for the men and material, embrasures for the guns, and well ventilated magazines, lined in a substantial manner with heavy timber, for the ammunition, space being allowed for 100 rounds per gun. The depth of the ditches was usually 6 feet, their width being regulated by the amount of earth required for the parapets. Glacis were thrown up to bring the ground in front under the musketry-fire from the parapets. Traverses were erected wherever a line was exposed to enfilade or oblique fire. Great care was taken to provide each of the larger works with flanking arrangements. When this could not be otherwise secured, counterscarp galleries were employed. In many cases advanced works, in the shape of rifle-trenches connected with the main works, were constructed. Wells were dug to supply the garrisons with water. Instead of a steep scarp, liable to erosion, the exterior slope of the parapet was continued to the bottom of the ditch.

But the most remarkable improvement upon the old methods was in the structures within the works. In addition to the substantial and roomy magazines already referred to, the larger works were provided with filling-rooms, implement-rooms, service magazines, and guard-rooms, either in the traverses or in separate structures, while nearly all contained capacious bomb-proofs. The latter were generally arranged to serve the purpose of a parados, or traverse, or interior retrenchment, in addition to their primary object, and were provided with a banquette along the rear, from which musketry-fire could be delivered upon an assaulting party which had succeeded in mounting the front parapet. See Gen. J. G. Barnard's *Defenses of Washington*, published as *Professional Paper Corps of Engineers U. S. Army, No. 20*, in 1871.

Block-houses.—The case frequently arises where it is necessary for a point of considerable importance to be guarded by a small detachment of men, and where circumstances do not permit the construction of a semi-permanent work. Such would be a bridge upon a line of communications passing through the enemy's country which it is necessary to guard against cavalry raids. In this case, instead of the redoubt often employed, engineers sometimes use the block-house. This is a building of which the sides are composed of heavy timbers placed vertical in juxtaposition, loopholed, and sometimes provided with embrasures for artillery. Earth is heaped up on the exterior to the height of the loopholes or embrasures, and a V-shaped ditch excavated to prevent the enemy using these against the defenders.

Historical Sketch of Fortification.—The origin of fortification is coeval with that of society. The character of the works has conformed to that of the weapons employed in the various ages of mankind. Thus among the wild tribes of the infant world, armed with clubs and weapons of stone, a wooden barricade or a bank of earth surmounted by a hedge was an efficient defensive work. The introduction of cutting tools of metal rendered these an easy prey to the attack, and a wall of masonry became necessary. As nations grew in power the height and thickness of these walls increased; some are said to have been 100 feet high. The greater their height, the more difficult they were to scale, and the more efficient were the missiles thrown from them; while the greater the thickness, the more space was provided upon them for the engines of war. To procure great thickness two walls were often built parallel to each other, the interval between them being filled with earth. The walls of Babylon are said to have been 70 feet thick, and are supposed to have been built in this way. To cover the men and material on top of this rampart, a thin wall was built up at the front part of it to the height of a man, and furnished with embrasures, through which stones and arrows were discharged at the enemy. To obtain a fire upon the foot of the wall, brackets were built out, and upon them were placed parapet-walls with embrasures. The next improvement was to build towers projecting from the general face of the wall, and providing a fire parallel to it. The distance between these towers was about the range of an arrow. It is doubtful when the ditch was introduced, but it was probably at an early date. During the Middle Ages the art of fortification, like the other arts and sciences, rather retrograded than improved.

The invention of gunpowder caused a radical change in all the methods previously employed. The high walls presented a marked and vulnerable object to projectiles of cannon; they had to be very much lowered. The top of an ordinary wall did not afford room for the guns; space was procured by throwing up a bank of earth on the interior. The towers had to be very much enlarged to receive the guns; they thus expanded into bastions. The walls, though lowered, were still exposed to being breached from a distance; outworks were therefore thrown up in front of them.

The Italians being in advance of the rest of Europe in all the arts, it was with them that the first great changes originated—Verona was surrounded by a bastioned enceinte in 1527—though the first modern writer was the celebrated German painter, sculptor, and architect, Albert Dürer, whose book is dated 1527. His ideas showed great originality and sagacity. He provided casemates, and flanked the faces of his polygon by enlarged towers, which he called bastions, though they rather resembled the caponnière than the modern bastion. The second great name in the modern art is that of Daniel Speckle, also a German, b. in 1536 at Strassburg, which city he fortified. He enunciated the principles that masonry must not be exposed to the distant view of the enemy, and that the nearer the general direction of the line fortified shall be to a straight line, the better. The first prominent French writer was Errard de Bar-le-Duc, whose book is dated 1594. He enunciated the principles that the minimum salient angle shall be 60°, and that the outworks must be seen into and commanded by the works in rear. His work was followed by that of De Ville in 1629, who made some improvements in details. Following Errard and De Ville, the next master was the Count de Pagan, whose work is dated 1645. He greatly increased the size of the demilune, and regulated the dimensions of the bastions and the distance between them, and improved the direction of the flanks and other details.

Vauban was born in 1633. Taking the method of Pagan, he enlarged the demilune, and provided it with an interior redoubt, invented the tenaille, enlarged the re-entrant places of arms, and constructed traverses along the covered way. Vauban restored 300 old fortresses, built 35 new ones, and besieged 53. He displayed extraordinary talent in adapting his works to the site, and he brought the bastioned system to a high degree of perfection. Coehorn was a contemporary of Vauban's, and adapted the system in a peculiar manner to the low lands of Holland. Vauban was followed by Cormontaingne, b. in 1696, who enlarged the demilune still further, introduced redoubts in the re-entrant places of arms, and made other improvements, leaving the system substantially as it is to-day.

The bastioned system was considered the only proper manner of fortifying until the latter part of the eighteenth century, when Montalembert, a French general of cavalry, produced his bold and original work. This "most intrepid of writers on fortification," as he has been styled, abandoned the bastioned trace, made large use of casemates, and used caponnières for flanking purposes, thus developing the ideas produced 250 years before by Dürer. He also advocated the tenailled system. It is upon the ideas of Dürer and Montalembert that the modern polygonal system is based, which has received such general employment throughout Europe. For seacoast fortification the casemates of Montalembert had a singular applicability. He is the first engineer who invented special designs for works "for the defense of ports," and he should be regarded as the originator of the casemated batteries subsequently so extensively employed by all nations.

The literature of fortification is very large. For a technical study of the subject, the reader is referred particularly to Zastrow's *History of Permanent Fortification*, originally published in German, but translated into French and published at Paris in 1856; Fallott's *Cours d'Art Militaire* (Paris, 1857); and the following works by Maj.-Gen. A. Brialmont, of the Belgian staff: *Études sur la Défense des États et sur la Fortification* (Paris, 1863); *Traité de Fortification Polygonale* (Paris, 1869); *Fortifications à Fossées Secs* (Brussels, 1872); *Fortification du Temps Présent* (Brussels, 1885); and *Influence du Tir Plongeant* (Brussels, 1888). For attack and defense of fortifications, see SIEGE.

O. H. ERNST.

Fortin, fōr'tăn', PIERRE: Canadian official; b. in Verchères, Quebec, in Dec., 1823, and graduated M. D. at McGill College in 1845. He served as surgeon at Grosse island 1847–48; in 1852 was appointed stipendiary magistrate for the lower river and Gulf of St. Lawrence, and organized the service for the protection of the sea and river fisheries in that district. In 1858 he was commissioned by the Canadian Government to visit the French colonies of St. Pierre, Miquelon, and Long Lake, and report conditions under which the French fisheries were carried on. In 1859 he established on all coasts and rivers of the Province of Quebec a system of licenses for salmon-fishing, and in 1862 began his series of descriptions of marine animals, fishes, etc., of the lower river and Gulf of St. Lawrence, which were printed in some of his annual reports to the Government. He had a seat in the Dominion Parliament 1867–74 and 1878–87; was commissioner of crown lands, Province of Quebec 1873–74, and Speaker of the Legislative Assembly 1875–76. While Speaker he founded the Marine Library of the province. He was one of the founders of the Geographical Society of Quebec, and its first president.

NEIL MACDONALD.

Fort Independence: a casemated, pentagonal, bastioned work located on Castle island, Boston harbor, Mass., begun 1832. It forms one of the defenses of the inner harbor of that port, being distant about 3 miles from the city. It is on the site of the old fortress called Castle William before and during the Revolution.

Fort Jackson: a pentagonal, bastioned, and casemated brick work, with glacis and wet ditch, on the Mississippi river, 78 miles below New Orleans, at what is known as the Plaquemine Bend. The designing of such a work on this soil was bold but successful; the considerable "settlement" has done no serious injury. In conjunction with Fort St. Philip it defends New Orleans against attack from the river. It was built mainly from 1824 to 1832, though extensively repaired, enlarged, and modified since 1841. The forcing of the passage of these works and their capture by the fleet of Farragut constituted the first great naval exploit of that commander. See FARRAGUT, DAVID GLASGOW.

Fort Leavenworth: a post-village of Leavenworth co., Kan.; on the Missouri river; 2 miles above Leavenworth (for location, see map of Kansas, ref. 5–J). It is situated on a bluff 150 feet high. Here in 1827 was established a U. S. military prison, which is now, however, under the jurisdiction of the Department of Justice. The U. S. reservation is 6 miles long and a mile wide, and is well laid out. The infantry and cavalry school is located here.

Fort Lee: post-village of Bergen co., N. J. (for location of county, see map of New Jersey, ref. 2–E); on the Palisades of the Hudson river, opposite 160th Street, New York city. It was once a military station, and fell Nov. 18, 1776, into the hands of Gen. Cornwallis, who here captured large amounts of military stores. Pop. (1895) 1,617.

Fort McHenry: an inclosed bastioned pentagon, with exterior batteries, on the west side of the Patapsco river, forming one of the defenses of the channel of approach to Baltimore, Md. It is an old work (second system), built prior to 1812; an attack during the war of 1812–15 furnished the theme for the well-known words of *The Star-spangled Banner*, by F. S. Key.

Fort Madison: city; capital of Lee co., Ia. (for location, see map of Iowa, ref. 7–K); situated on Mississippi river, 23 miles below Burlington, and on the Atch., Top. and S. Fé, Burl. Route, and Ch., Fort Mad. and Des Moines R. Rs.; 237 miles S. W. of Chicago; connected with Illinois by one of the finest wagon and railway bridges on the river. It has numerous churches and schools, a business college, a public library, three parks, a State penitentiary, shops of the A., T. and S. F. Railway, foundries, tanneries, large packing-houses, and manufactures of agricultural implements, machinery, railway-car wheels, boots and shoes, flour, brick, lumber, sash, doors, blinds, and furniture. The city is the site of a fort built in 1808, and captured by the Indians in 1818. Pop. (1880) 4,679; (1890) 7,901; (1900) 9,278. EDITOR OF "PLAIN DEALER."

Fort Marion: an inclosed work at St. Augustine, Fla., begun by the Spaniards about 1650 and completed in 1756. It is the oldest fort in possession of the U. S. Government, and is from its antiquity an object of attraction to strangers visiting ST. AUGUSTINE (*q. v.*). It is not of much value, but is carefully preserved as an object of historic interest.

Fort Mifflin: one of the inner line of defenses of the port of Philadelphia, Pa.; on Mud island, Delaware river, below the mouth of the Schuylkill. It is one of the older (or second) system of works. It was attacked by a British man-of-war Oct. 23, 1777, and after a spirited resistance was taken on Nov. 16. The fort has been modified and repaired.

Fort Monroe: a fortification located on Old Point Comfort, Va., for the defense of Hampton Roads and the water-approach to Norfolk and the Gosport navy-yard. It stands on the north side of the channel, Fort Wool (formerly Fort Calhoun) being on the south side, about a mile distant. Fort Monroe might properly be called a fortress or fortified place, as it incloses a large area, and contains within it a number of detached buildings, such as officers' quarters, offices, barracks for soldiers, storehouses, a portion of the workshops of an arsenal, the artillery school of the service, a chapel, etc. It was commenced in 1817, and was originally designed to mount 371 guns in casemates and *en barbette*, inclusive of mortars, field-pieces, and flanking howitzers. In plan it is an irregular hexagon, on two sides of which, comprising the three channel fronts, the armament is arranged in two tiers, one in casemates and one in barbette. On the other four sides, each being one front, the ramparts are solid, with the exception of some of the flanks, which are casemated. The work is bastioned, although unaccompanied by the usual outworks of the regular bastioned system. It is surrounded by a tide-water ditch, 8 feet deep at high water, exterior to which there is a casemated battery on the channel front to the left of the casemates of the main work, and a quadrilateral redoubt on the north side, commanding the approach down the peninsula. This redoubt, like the main work, is surrounded by a wet ditch. The scarp-wall of the main work rises to the height of 17 feet above high water. The entire fort covers an area of 80 acres, and the distance around it, exterior to the ditches of main work and redoubt, is $1\frac{6}{10}$ miles. In its construction there was expended $2,818,000. This fort is (1893) being modified to fit it to the requirements of modern defense, an efficient armament of modern steel rifled cannon and mortars properly protected being provided, supplemented by a system of submarine mines. Inasmuch as the exceptional magnitude of Fort Monroe, as compared with other works of coast and channel defense in the U. S., has been the subject of frequent, and perhaps not unjust, criticism, it may be said, in explanation, that this work was designed under the inspiration of Gen. Simon Bernard, a foreign engineer of eminence, called into the service of the U. S. soon after the close of the war of 1812–14, with all the exaggerated ideas of warfare which the close proximity of belligerent nations in Europe had produced and rendered orthodox. There is no other work at all like it in the U. S. in any essential particular, and the error in this instance relates solely to magnitude, not to strength.

Revised by JAMES MERCUR.

Fort Morgan: an inclosed casemated and bastioned pentagon of brick, with exterior batteries; located on the west end of Mobile Point, Ala., at the entrance to anchorage in Mobile Bay; begun in 1819 on the site of old Fort Bowyer. An historic interest attaches to the latter work as having borne an important part in the war of 1812–15. It then consisted of only a small redoubt. In pursuance of the plan adopted by the British, "to destroy and lay waste all towns and districts of the U. S.," the Indian war was renewed on the southern frontier, and on Sept. 15, 1814, a combined naval and land attack was made upon Fort Bowyer, then but a small redoubt mounting 20 guns, and with a garrison of 120 men, officers included. The British force comprised 4 armed vessels, 590 men, and 90 guns, and a land force exceeding 700 men, of which 600 were Indians. The British lost a ship and 232 men. The work was taken by the British Jan. 11, 1815. It was captured from the Confederates by Admiral Farragut Aug. 22, 1864.

Fort Moultrie, mōl'trē: a fortification on Sullivan's island, entrance to Charleston harbor, S. C. A rude work of palmetto logs and earth, mounting 26 guns, was unsuccessfully attacked in 1776 by the British fleet of nine vessels (270 guns), under Sir Peter Parker, and thenceforth bore the name of the commander, Col. William Moultrie. It was subsequently rebuilt in masonry with an imperfectly bastioned tracé, and described in official reports as a "work of some strength, but with scarp-wall so low as to oppose no serious obstacle to escalade." And such it was, essentially, at the time when (Dec. 26, 1860), abandoned by Major Anderson, it fell into Confederate hands, and together with the batteries on Morris island fired the first guns of the civil war upon the Star of the West, Jan. 9, 1861. (See FORT SUMTER.) In Confederate hands the work was re-enforced by earthen batteries extending the whole length of Sullivan's island. Since the civil war it has been very much modified to adapt it to receive modern heavy guns, protected by earthern traverses and parados. The Seminole warrior Osceola is buried just outside the walls of the fort.

Fort Niagara: an inclosed work in Niagara co., N. Y., at the mouth of Niagara river, the entrance to which it commands. The old work of this name bore a prominent part in the war with Great Britain in 1812–15, and was the scene of stirring events, being surprised and captured in 1813, when most of its garrison were slain.

Fort Ontario: See OSWEGO.

Fort Payne: city; capital of De Kalb co., Ala. (for location of county, see map of Alabama, ref. 2–E); on railway; 50 miles S. S. W. of Chattanooga, Tenn.; in a coal and iron mining region. It has rolling-mills, an iron-furnace, fire-clay works, and sawmills. Pop. (1890) 2,698; (1900) 1,037.

Fort Pickens: an inclosed casemated and bastioned pentagonal brick work, on Santa Rosa island, Pensacola harbor, Fla., which harbor and the U. S. navy-yard at Warrington it is intended to defend. In Jan., 1861, Maj. Adam Slemmer abandoned the small work, Fort Barrancas, opposite, and transferred his command to Fort Pickens, which he succeeded in holding until re-enforced.

Fort Plain: village (settled about 1715; incorporated in 1832); Montgomery co., N. Y. (for location of county, see map of New York, ref. 4–I); situated on the Mohawk river, on the Erie Canal, and on the N. Y. C. and H. R. and West Shore Railways; 58 miles W. of Albany. It has six churches, the Clinton Liberal Institute (Universalist), one of the largest spring and axle works in the U. S., a very large furniture-factory, knitting-mill, silk-mill, wood-working establishment, etc., and is the center of an important hop-raising and dairying section. A strong fort was erected here in 1778, and a block-house in 1780. Pop. (1880) 2,443; (1890) 2,864; (1900) 2,444.

EDITOR OF "REGISTER."

Fort Pulas'ki: a fortification constructed on Cockspur island, Ga., for the defense of Tybee Roads and the Savannah river approach to the city of Savannah; begun in 1829, and finished at the beginning of the civil war in the U. S. at a cost of nearly a million dollars. Upon the secession of Georgia from the Union her military took possession of the fort, but on Nov. 29, 1861, Gen. Quincy A. Gillmore, chief engineer to the expeditionary corps commanded by Gen.

W. T. Sherman, made a reconnoissance of the works and pronounced the reduction of the work practicable by means of batteries of mortars and rifled guns established on Big Tybee island. From December till spring the preparations went on. The island was occupied by Union troops, and batteries were placed at adjacent points, the material for their construction, as well as the ordnance and ordnance-stores, being carried with infinite difficulty over the swampy soil. The positions selected for the most advanced batteries were screened from view from the fort by brushwood and bushes, and concealment was maintained until the work was far advanced. The batteries opened fire on Apr. 10, 1862, and though but few of the Union shells burst within the inclosure, the balls from the rifled guns chipped and tore away the masonry to such an extent as to threaten the fort with complete demolition, and on the afternoon of the following day its garrison surrendered. The credit for this victory, which was gained at a trifling sacrifice of life on either side, is due to Gen. Q. A. Gillmore. See his *Report on the Siege and Reduction of Fort Pulaski* in *Professional Paper No. 8 of the Corps of Engineers.* See also BOMBARDMENT.

Fortress: a place made strong and defensible, so that a small number of men may hold it against a larger force. This is the general term, not used in any exact or technical sense; it implies usually a place of considerable size and a permanent work, rather than an intrenched camp or the like. Ancient fortresses differ radically from modern ones in this respect, that the attack and defense of the works were *vertical* before the introduction of guns throwing heavy balls horizontally, a change dating not earlier than 1500 A. D., while since that time the attack and defense have been *horizontal.* The modern fortress is low, and not to be seen from afar; its grassy slopes are lost in the landscape. The ancient fortresses, from the time of the early empire in Egypt, as at El Kab or Abydos, to Pierrefonds, N. E. of Paris, finished in 1400 A. D., were lofty and imposing structures, crowning a height or isolated in a lake, lifting their battlemented towers high above all surrounding objects.

The manner of attack upon a fortress must always determine the character of the defensive works. During all the ages before the introduction of breeching guns there were but four methods of attack: by escalade, by forcing or surprising gateways, by mining underneath the walls, so as to throw them down, and by battering-rams, the pickax, or other such methods of breaching the wall above ground. To resist escalade the walls were made high; to resist breaching they were made thick; to make the gates defensible elaborate and ingenious combinations were devised; while mining could be prevented only by the rocky nature of the soil, or by position upon high scarped cliffs, or by water, and could be opposed only by countermines, or by sorties of the garrison. Missile weapons were secondary in importance. Arrows and bolts were used to drive the defenders from the walls at the moment of assault, and to repel the assailants, and heavy stones and darts as large as iron-shod rafters were used to destroy battlements and wooden defenses of all sorts; burning missives were used also to set fire to the stockades, palisades, and wooden galleries. The largest *pierrières* of the Middle Ages could throw a 300-pound stone perhaps 600 feet; but not many of these in an hour, and with not very exact aim; moreover, such a machine contained an enormous amount of solid timber, occupied a space of perhaps 800 sq. feet, and took many days to set up and adjust for use. It will be seen, then, that the main walls and towers of a city or castle had nothing to fear from missiles. The assailants had to crowd close under the walls to scale them or to breach them, and the defense consisted of a steady shower of darts, arrows, stones, and unslaked lime, with fire-arrows aimed at the wooden mantlets and scaling-towers of the attacking party. The higher the wall the heavier the blow struck by a rounded stone falling from its top, the harder to reach it by ladders, and the harder to match it with movable towers. Accordingly, the defenders of Pierrefonds stood upon a solid pavement not less than 80 feet above their assailants, while aid came to them from fellow defenders in towers rising on either side from 40 to 60 feet higher still; the donjon of Coucy had 180 feet of sheer unbroken wall before the galleries of defense began; and the pope's palace at Avignon has walls generally from 80 to 120 feet in clear vertical height above the pavements of the streets throughout its perimeter of nearly a third of a mile, with towers rising much higher. Then to resist the ram and the pick a thickness of from 10 to 16 feet was given to the walls, and often the whole basement of a tower, as of the great donjon of Châteaudun, was of solid masonry without any open space inside. Moreover, it was very common to arrange the location and the levels of a fortified place, even on tolerably even natural ground, so that the level without would be from 10 to 30 feet lower than that within, and so that the outer surface of the stone wall might be a mere facing, the true foundation being above on an artificially leveled table of rock, out of reach of the mines and galleries of sappers.

Next in importance after the strength of the walls and towers was the protection of the persons of those who manned the wall. The simplest and most obvious means of protecting them against missive weapons was the *battlement*, a device used by the Egyptians 4000 years B. C., by the Greeks, the Persians, the Romans, and the Europeans of the Middle Ages alike, as their monuments show. Piers of masonry, from 6 to 8 feet wide and 6 feet high above the top of the wall, alternate with spaces where the parapet is only about 4 feet high. The soldier shoots over the low parapet and shrinks back behind the *merlon.* Sometimes the merlon is pierced by a long slit for discharging arrows. In the defenses of Pompeii each merlon has a bit of wall carried back like a buttress, so as to protect the left side of the soldier using it, who, of course, shoots from his own right shoulder. In the thirteenth-century fortresses the row of battlements was carried out beyond the face of the wall on corbels, so as at once to widen the *chemin-de-ronde* or broad walk on the top of the wall, and to leave open spaces between the corbels, through which heavy stones could be dropped upon the assailants at the very foot of the wall, and that without exposing the defenders in the least. But there grew up in the thirteenth and fourteenth centuries an elaborate system of temporary wooden defenses put upon the walls when a siege was expected. These projected far beyond the face of the wall, and gave excellent "command" of the base of wall as well as perfect cover for the archers and cross-bowmen. It was therefore the first aim of the besiegers to destroy these by heavy stones or by burning barrels of combustibles thrown by a *trébuchet* or *mangonel.*

Much the most important ancient fortress remaining nearly complete to modern times is Rome, whose walls built by Aurelian and Honorius have been preserved nearly intact for the greater part of their extent. The battlements have been many times restored, no doubt, but these can be compared with the almost intact example of Pompeii. Generally, while the plan and distribution of an ancient fortress can be made out with but slight excavation and removing of obstacles, the details of the defensive appliances at top are lost. Bas-reliefs. as on the columns of Trajan and Antonius at Rome, and on the wall of the Temenos at Gjölbasschi, and wall-paintings, as in Egypt, help us to restore these in imagination. Of the fortresses of the Middle Ages many remain in excellent condition for study; several in Syria, built by the crusaders, being almost intact; the great inclosed place at Villeneuve, opposite Avignon, retaining all its defensibility except for a breach or two in the walls; and the tower of Philip the Fair near by, and the walls of the city of Avignon itself, having needed and received but slight repairs, and so with many instances. As with other ruins, the near neighborhood of a large population brings swift destruction to the lighter and more easily removed stone work; a lonely and removed situation is the best safeguard until government protection is given.

RUSSELL STURGIS.

Fort Royal (Martinique): See FORT DE FRANCE.

Fort St. Philip: a fortification nearly opposite FORT JACKSON (*q. v.*), on the Mississippi river. The old river-front, with low brick scarp and wet ditch, was built by the Spaniards. The Plaquemine Bend offers the lowest favorable locality for defending the river, though it is 15 miles above the mouth and 30 above the Head of the Passes. The work was wholly inclosed by the U. S. authorities during the war of 1812–15, but, like nearly all works of that and earlier date, it is of rude design both in trace and in relief. Since 1841 it has undergone extensive repairs and modifications. At the outbreak of the civil war in 1861 it fell into the hands of the Confederates, but was, with Fort Jackson, captured by Farragut's fleet Apr., 1862.

Fort Schuyler, skī'ler: See NEW YORK (city).

Fort Schuyler: the name given in 1776 to the old Fort Stanwix which stood on the site of the present city of Rome, N. Y. It was unsuccessfully besieged by St. Leger's Tories and Indians in 1777, and was destroyed by fire and freshet in 1781. Fort Stanwix was built in 1758, and cost the British Government £60,000.

Fort Scott: city and railway center; capital of Bourbon co., Kan. (for location of county, see map of Kansas, ref. 7–K); situated on the Marmaton river; 300 miles W. of St. Louis and 98 miles S. of Kansas City, Mo. It is the seat of a normal college, and has an iron-foundry and machine-works, grain elevator, large flour-mills, woolen-mills, paint and cement works, window-glass works, and a large sorghum-sugar factory. Coal and flag paving-stone are found in the vicinity, and large quantities are shipped from the city. Hydraulic cement and mineral paints, umbers, yellow ochers, Spanish brown, Indian red, etc., are found in large quantities. Pop. (1880) 5,372; (1890) 11,946; (1900) 10,322.
EDITOR OF "TRIBUNE."

Fort Smith: city and railway center; one of the capitals of Sebastian co., Ark. (for location of county, see map of Arkansas, ref. 2–A); situated at the confluence of Arkansas and Poteau rivers; 158 miles W. by N. of Little Rock. It has sawmills, planing-mills, furniture-factories, cotton compress and oil-seed mills, ice-factory, etc., and an important trade in coal, cotton, grain, lumber, hides, and furs. Pop. (1880) 3,099; (1890) 11,311; (1900) 11,587; besides a suburban population of about 2,000. EDITOR OF "TIMES."

Fort Snelling: village; Hennepin co., Minn. (for location of county, see map of Minnesota, ref. 9–E); on the Ch., M. and St. P. Railway, at the junction of the Minnesota and Mississippi rivers, opposite Mendota, and 2 miles below the Minnehaha falls. It was founded in 1820, is an old U. S. military post, and the oldest settlement in what is now Minnesota. Pop. (1890) 550; not returned separately in 1900.

Fort Sumter: Charleston, S. C.; noted for being the place where the U. S. civil war was begun, Apr. 12, 1861, and as the scene of several severe military and naval conflicts during that war. The work, begun in 1829, is located upon a shoal on the south side of the entrance to the inner harbor, distant about a statute mile S. W. from Fort Moultrie, and $3\frac{1}{3}$ miles from Charleston city. The land nearest the work is Cummings Point, on the north end of Morris island, about three-quarters of a mile distant, in a southerly direction. The fort was built of brick on a rip-rap foundation, the exterior wall being 38 feet high and $7\frac{1}{2}$ feet thick, and was designed to mount 136 guns arranged in three tiers, two in embrasure and one *en barbette*. It never received its entire armament, as none of the embrasures of the second tier were finished when the civil war broke out. The openings left for them were therefore walled up with brick, in order to render the work as strong as possible to resist the threatened attack of the Confederates. Up to that time a little more than $1,000,000 had been expended upon it, and its armament comprised 6 24-pounders, 41 32-pounders, 10 8-inch Rodman guns, 10 42-pounders, 3 10-inch columbiads, and 8 8-inch seacoast howitzers.


View of Fort Sumter from Morris island, Aug. 16, 1863.

South Carolina formally seceded Dec. 20, 1860, in the midst of the wildest rejoicing and exultation throughout the South. The entire force of U. S. troops in Charleston harbor at the time consisted of two companies of the First U. S. Artillery and nine musicians, a total of seventy-five enlisted men, under the command of Maj. Robert Anderson. This handful of men, which had hitherto occupied Fort Moultrie in consequence of the unfinished condition of Fort Sumter, was quietly transferred to the last-named work during the night of Dec. 26—an event at once followed by the seizure, by the State authorities, of all the other forts in the harbor, and the U. S. arsenal, post-office, and custom-house in Charleston city. The construction of batteries on Morris island was begun, the coast and harbor lights were extinguished, and the buoys removed from the channel to prevent the sending of re-enforcements and supplies to Fort Sumter. On Jan. 9, 1861, the steamer Star of the West arrived in the harbor with provisions and 250 Federal soldiers. In attempting to reach Fort Sumter she was fired into and struck from batteries on Sullivan's and Morris islands, and abandoned the enterprise. As Maj. Anderson's provisions would be exhausted on Apr. 15, official notice was conveyed to Gov. Pickens, of South Carolina, on the 8th that supplies would be conveyed to the fort at all hazards. Its surrender was demanded by Confederate General Beauregard at 2 P. M. on the 11th, and refused. To another communication of the same date, Maj. Anderson replied that the work would be evacuated on the 15th unless "controling instructions" or "additional supplies" were received by that time. This response not being deemed satisfactory, Maj. Anderson was notified at 3.20 A. M. on the 12th that fire would be opened on the fort in one hour, and the cannonading began at the appointed time. At noon on the same day a fleet of vessels from New York, with provisions for the garrison, appeared off the harbor and exchanged signals with the fort, but made no attempt to land any supplies, without which the contest must necessarily be of brief duration. On the afternoon of the 13th terms were arranged, under which the garrison marched out on the 14th with the honors of war, saluting the U. S. flag with fifty guns.

The brick buildings erected inside the fort for quarters and barracks were burned down during the action by hot shot from the Confederate batteries, but the work itself had received no material injury. Contemporaneous opinion, outside a somewhat restricted military circle, very generally conceded the difficulty, if not the impracticability of throwing re-enforcements and supplies into the fort during the attack, but in the light of subsequent events such an enterprise loses most of the elements of extreme hazard. The lower embrasures, forty-one in number, and each nearly 2 feet wide and 3 feet high, were only 4 feet, in many places not over 3 feet, above the enrockment at the foot of the outer wall, and not more than 10 feet distant from the water, which encircled the fort on every side. If thirty or forty small boats carrying rations and soldiers, and manned by such men as a call for volunteers would bring out in any fleet of U. S. merchantmen, had attempted to make a landing simultaneously on all sides of the work during the night of the 12th, a large proportion of them would doubtless have succeeded. The opposition, if any, would have come from boat-parties similarly organized, which, at the worst, would only place the combatants on a footing of theoretic equality, in which the best men and the best weapons would win.

The Confederates, upon getting possession of Fort Sumter, at once proceeded to augment its offensive and defensive strength. Rifle-guns were added to the armament; many of the casemates were filled up with sand; sand traverses were constructed between the barbette guns, and the magazine walls were strengthened. They held undisturbed possession for a period of two years.

On Apr. 7, 1863, a gallant attack was made upon the fort by a U. S. naval force of nine ironclads, carrying twenty-three guns, under command of Rear-Admiral Samuel F. Dupont. The vessels engaged were the Weehawken, Passaic, Montauk, Patapsco, New Ironsides, Catskill, Nantucket, Nahant, and Keokuk. The combat lasted one hour and forty minutes, when the fleet withdrew, at 4 P. M., with the intention of renewing the engagement the next morning. The monitors had received so much injury, however, that the project was abandoned. The Keokuk, a thin-armored, double-turreted monitor, sunk the next day from the injuries received in her hull, although she had been under fire only thirty minutes. She had been struck ninety times, and nineteen shots pierced her through at and below the water-line. In this engagement the ranges varied from 550 to 2,100 yards. The fleet, armed almost exclusively with 11-inch and 15-inch smooth-bores, with a few 150-pounder rifles, fired only 139 times. Of these, 54 15-inch shells, 43 11-inch shells, 22 11-inch solid shot, and 5 150-pounder rifle projectiles were fired at Fort Sumter, and the rest at Forts Wagner and Moultrie. Fort Sumter was subsequently bombarded, its batteries destroyed, and the walls upon two of its faces demolished, from batteries established by the Union land forces on Morris island. The first fire from the breaching batteries opened Aug. 17, 1863. At 12 P. M. on the night of Sept. 8 the fort was assaulted by a naval column of 500 men in small boats, which was repulsed with heavy loss. A preliminary summons for its surrender had been made by Admiral Dahlgren.

A prominent historian of the war asserts, on the alleged authority of the naval commander, that co-operation from the army was expected in this assault, in accordance with previous arrangement. Such is not the case. On the contrary, although an assault had been ordered by the commander of the land forces the same night, the admiral was informed that the column could not start from the creek W. of Morris island until midnight, in consequence of low tide. The naval column left the fleet at 10 P. M., and by midnight had been repulsed and withdrawn. The only arrangement between the navy and army commanders consisted in the adoption of a watchword to prevent unpleasant collisions on the water between the two forces. Each enterprise was organized with ample strength to act alone, and was intended to be entirely independent of the other, and no reference whatever to any expected co-operation from the army was made by the admiral or by any of his subordinates in their official reports of the action.

The Fort Sumter garrison subsequently constructed additional shelters, galleries, and quarters within and under the ruins, and maintained possession until the final evacuation of Charleston and all its defenses Feb. 18, 1865.

The work has been rebuilt on a modified plan, and mounts large guns *en barbette* and guns in casemate. For demolition of Fort Sumter, see Gen. Gillmore's *Report on Engineer and Artillery Operations against Charleston*; also article BOMBARDMENT.

Fort Tompkins: a fortification on the west side of the Narrows, entrance to New York harbor; lat. 40° 36′ 1″ N., lon. 74° 2′ 58·2″ W. See NEW YORK (city).

Fortuna [= Lat. *Fortuna*, equiv. to Gr. Τύχη]: the goddess of good luck, worshiped at many places of Italy, Greece, and Asia Minor. She is most often represented holding in one hand a rudder, in the other the horn of plenty; sometimes also with a ball or wheel at or under her feet. She was especially honored at Rome, where she had several temples and bore many surnames. G. L. H.

Fortunate Islands [transl. of Lat. *Fortunatæ Insulæ*, transl. of Gr. Μακάρων Νῆσοι, Islands of the Blessed]: an ancient name for a group of supposed islands of the ocean stream, whose genial climate is celebrated by Homer. The geographers identified them with what are now called the Canary islands, but the term in a wide sense seems to have included the Azores, Madeira, and the Cape Verde group. The delightful climate of all but the most southerly group of these islands justifies the name.

Fortunatia'nus, ATILIUS: a Roman grammarian of the fourth century; author of a treatise on meters, and especially on the meters employed by Horace. The work is compiled from previous writers for the use of a young Roman of senatorial rank, to whom the author recommends the careful study of Horace. In order to explain for him the meters of the poet, Fortunatianus gives first a summary of the different kinds of feet and the principal meters, with some of the leading rules of prosody. He then takes up and analyzes the Horatian measures. The work is given in Gaisford's *Script. Lat. Rei metricæ* (Oxford, 1837), and in vol. vi. of Keil's ed. of the Latin grammarians.

Revised by M. WARREN.

Fortuna'tus: the hero of an old romance, the first known edition of which appeared in German at Frankfort in 1509, the second in 1530. Fortunatus, after great sufferings, receives an inexhaustible purse and a wishing-cap, which finally proves the ruin of him and his sons. Another popular character, Fortunio, is believed to have been at first identical with him. The story of Fortunatus was dramatized by Hans Sachs, *Der Fortunatus mit dem Wunschseckel* (1553), and by Dekker, *Pleasant Comedie of Old Fortunatus* (1600). The principal European languages have the tale in various forms. Its authorship is not known, but some of its materials are very old. The "inexhaustible purse" of Fortunatus forms one of the prominent features of the strange tale of *Peter Schlemihl* (by Chamisso), who for it sold his shadow.

Fortunatus, VENANTIUS HONORIUS CLEMENTIANUS: Bishop of Poitiers; a Latin poet of the transition period, who wrote on a great variety of subjects: he owes his reputation mainly to three or four beautiful Latin hymns. He was born in Northern Italy, in the neighborhood of Ceneda and Treviso, about 530 A. D., but received his education at Ravenna, where he studied grammar, rhetoric, and jurisprudence, devoting considerable attention also to eloquence and poetry. About 564 he left Italy for France, where he spent the rest of his life. He was favorably received at the court of Siegbert, King of Austrasia, in honor of whose marriage with Brunhilda he composed an epithalamium in the manner of Claudian, and resided there for some time as a sort of court-poet. After visiting Tours in fulfillment of a vow to St. Martin, he repaired to Poitiers, where he met Radegunde, the queen of Clothaire I., who was living in a cloister which she had founded in the vicinity, and attracted her attention and regard. He here took orders, became a presbyter, and almoner and chaplain of the queen, and under her patronage devoted himself to ecclesiastical studies and literary production. On the death of the Bishop of Poitiers, Fortunatus succeeded to the episcopate (not earlier than 592), which office he retained till his death, about 600. His works are very numerous in prose and verse, consisting of lives of distinguished men, bishops, confessors, and others; explanation of the Lord's Prayer and of the Creed; an epic poem in four books on the life of St. Martin, chiefly copied from the narrative of Sulpicius Severus; and nearly 300 poems, collected in eleven books, on a great variety of subjects and in different meters. Fortunatus stands on the border-line, as it were, of the old classical poetry and the mediæval accentual (of which he was one of the first writers), adopting in his poems both varieties, and showing no great regard for Latin quantities. The best edition of his works is by Leo and Krusch (2 vols., Berlin, 1881 and 1885, vol. i. containing his poetical, vol. ii. his prose works). His beautiful hymn, *Vexilla regis prodeunt*, was adopted by the Church, and has been translated into several modern languages (into English by J. M. Neale in *Mediæval Hymns*, and by Mrs. Charles in *Christian Life in Song*). It, with several others, appears in the greater collections, but is made generally accessible in Trench's *Sacred Latin Poetry* (London, 1874, 3d ed.) and in March's *Latin Hymns* (New York, 1874). See Manitius, *Geschichte der Christ. Lateinischen Poesie* (Stuttgart, 1891, pp. 438–70); Guizot, *History of Civilization*, 18th lecture; Ebert, *Gesch. d. Christlich-Lateinischen Literatur* (Leipzig, 1889, pp. 518–542.)

Revised by M. WARREN.

Fortune, ROBERT: author and botanist; b. in Berwickshire, England, in 1813; educated at a village school in the Merse; selected horticulture as his occupation, and was employed in the botanical gardens of the Scotch capital, then in those of Chiswick; later in life he was for a few years director of the botanical garden at Chelsea. In 1842 was made collector of plants for the Botanical Society of London in Northern China; in 1847 published *Three Years' Wanderings in Northern China*. Visiting China in 1848 to make investigations concerning the tea-plant for the East India Company, he published, after an absence from England of three years, his *Two Visits to the Tea Countries of China*. He again visited China in 1853, and spent three years, publishing in 1857 *Residence among the Chinese Islands*. He in 1859 collected in China, for the U. S. Government, the seeds of the tea-shrub and other plants, and in 1863 published *Yedo and Peking*. D. Apr. 16, 1880.

Fortuny y Carbó, fōr-too′nē̆e-ee-kaar-bō′, MARIANO: genre-painter; b. at Rëus, Catalonia, Spain, June 11, 1838. Pupil of Palan, Claudio Lorenzalez, and of the Barcelona Academy; Prix de Rome, Barcelona Academy, 1856; went to Morocco in 1859 to paint pictures of Gen. Prim's campaign; went to Paris in 1866, but spent almost the whole of his life in Rome. His pictures are notable for brilliant qualities of color and extreme cleverness of manipulation. They sold for high prices during his lifetime, and are much sought for by collectors in Europe and the U. S., where many of his principal works are owned. *Camels at Rest* is in the Wolfe collection, Metropolitan Museum, New York; *Arab Fantasia* and *Court Jester* in the collection of Mrs. W. H. Vanderbilt, New York. D. in Rome, Nov. 21, 1874.

Fort Valley: town and railway junction; Houston co., Ga. (for location of county, see map of Georgia, ref. 5-H); 29 miles S. W. of Macon. It has a large trade in fruit, cotton, and other agricultural products. The surrounding region is of the very first rank in the production of peaches and pears. Pop. (1880) 1,277; (1890) 1,752; (1900) 2,022.

Fort Wadsworth: a casemated stone fort at the entrance to New York upper harbor. See NEW YORK (city).

Fort Washington: a former suburban village of New York, now in the city limits; on Hudson river; in the north part of Manhattan island. The fort, of which some remains still exist, stood between what are now 181st and 186th Streets, on the highest land upon the island, and during the Revolution it was an important point. It was taken, with 2,600 prisoners, by the British Nov. 16, 1776, after a gallant defense. It was attacked at once by Gen. Knyphausen with six German regiments moving up from the flats along the rough hills nearest the Hudson; by Lord Percy with a division of English and German troops on the southern side; and by Gen. Matthews with the guard and Col. Sterling with a body of Highlanders, crossing the Harlem river at two different points. See E. P. Delancey, *On Fort Washington* (1878).

Fort Wayne: city and important railway center; capital of Allen co., Ind. (for location of county, see map of Indiana, ref. 3-G); on the Ft. W., Cin., and Lv., Findlay, Ft. W., and W., Grand Rapids and Ind., L. S. and M. S., N. Y., Chi., and St. L., Penn. Co., and Wabash Rys., at the confluence of St. Mary's and St. Joseph rivers, which here form the Maumee; 94 miles W. S. W. of Toledo, O. The city is regularly laid out in well-paved streets, and covers an area of nearly 6 sq. miles. It is the seat of Concordia College (Lutheran) and Fort Wayne College of Medicine, and has 47 churches, 35 public and parochial schools, 2 well-appointed libraries, 2 hospitals, 2 orphans' homes, and 7 public parks. The handsome Government building cost $200,000. There are also a new county court-house, erected at a cost of $1,000,000, a $125,000 manual-training and high-school building, and a $75,000 public library, the latter the gift of Mr. Andrew Carnegie; and 1 private and 4 national banks represent a capital of $2,500,000.

Manufactures, etc.—There are extensive railway-shops, foundries, machine-shops, flouring-mills, and manufactures of baking-powder, wagons, and lumber; a general electric-light plant employing 900 men, two knitting-mills employing 450 men, etc. The city has over 32 miles of street-railways, an excellent system of sewerage, and electric lights.

The town originated in a fort built by Gen. Anthony Wayne in 1794. The first city charter was granted in 1839. The place is surrounded by a fine agricultural community, and is the leading city of Northern Indiana. Pop. (1840) 1,200; (1880) 26,880; (1890) 35,393; (1900) 45,115.

Fort William: an important railway and shipping point on Thunder Bay, north shore of Lake Superior, in Western Ontario (see map of Canada, ref. 9-J). It has the elevators and terminal shops of the Canadian Pacific Railway, and is a favorite summer resort. Pop. 2,800. M. W. H.

Fort William Henry: a fortress in Warren co., N. Y., near the head of Lake George; erected in 1755 by the British forces under Sir William Johnson. It became an important strategic point in the last French war in the colonies, and was captured by about 9,000 French and Indians under Montcalm in 1757. The fort was garrisoned by about 3,000 English troops under Col. Munro, and at only 15 miles' distance stood Gen. Webb with 4,000 men. Munro applied for aid from Webb, but as none was furnished he was finally compelled to surrender. The fort was then destroyed.

Fort Worth: city and important railway center; capital of Tarrant co., Tex. (for location of county, see map of Texas, ref. 2-H); situated on Trinity river, 32 miles W. of Dallas and 210 miles N. of Austin. It has 39 churches, Fort Worth University, Polytechnic Institute, St. Ignatius Academy, Fort Worth Medical College, Academy of Music, 2 business colleges, high school, 12 public schools, 8 private schools, and a fine board of trade building. Among its chief industrial establishments are 4 grain elevators, 4 flouring-mills, a cracker-factory, 2 iron foundries, a cotton-oil mill, excelsior-factory, car-works, shops of the Fort Worth and Denver, the Texas and Pacific, and the Rio Grande Railways, large stock-yards, and one of the largest packing-houses in the Western U. S.

The U. S. census for 1890 shows 311 industrial establishments, with a capital of $3,184,872, giving employment to 2,649 persons, at an annual wage of $1,882,116. The cost of materials used was $3,379,519, and the value of products $6,691,621. The city has 200 private artesian wells for drinking water, besides city water-works for drinking, sewerage, and fire purposes. It has 60 miles of macadamized streets, 60 miles of sewers, 20 miles of electric railways, and a complete system of electric lights owned by the city, 7 national banks, and 2 daily newspapers. Pop. (1880) 6,663; (1890) 23,076; (1900) 26,688. EDITOR OF "MAIL-TELEGRAM."

Fo′rum [of uncertain etymology, perhaps connected with *foris* (*fores*), Gr. θύρα]: seems originally to have been applied to any open space in front of buildings or surrounded by them, and so, for example, to the area in front of a sepulcher, as appears from a fragment of the laws of the Twelve Tables. The term was usually applied to an open place in Rome, like the Greek ἀγορά, for the assembly of the citizens for business, for legal transactions, for the administration of justice, and for the sale and purchase of goods. With the growth of the city the necessities of the people required more than a single forum, and convenience separated them into those devoted to public affairs and those which were more strictly markets or bazaars. The most celebrated and the most important of the *fora* of the former class was the Forum Romanum, sometimes called Magnum, and from its pre-eminence simply Forum. This was the earliest, and for a time the only one, and was situated in the valley between the Capitoline and Palatine hills, and with it is associated very much of the interest of the public and private life of early Rome. It was the very heart of the city, the center of all its life and activity, and in it were gathered daily those whom business summoned, the orators and public men of the day with their bands of clients, as well as the idlers who sought only to be amused, with trains of quacks and mountebanks, so pleasantly described by Horace. (For the buildings in and around the Forum, see ROMAN ARCHÆOLOGY.) Immediately adjoining this a new forum was erected at great expense by Julius Cæsar, which was called from him Forum Julium. It contained a temple of Venus Genitrix (in allusion to his descent from the goddess), which was vowed by Cæsar after the victory at Pharsalus, and was dedicated in 46 B. C. This still failing to accommodate the increasing pressure of the business of the courts, Augustus constructed still another, which received from him the name Forum Augusti. It contained within it a temple of Mars Ultor, which Augustus had vowed to erect on avenging the death of his adoptive father. This forum was more contracted than Augustus had designed on account of the refusal of some owners of houses to part with their property. Still other fora were erected by the later emperors, partly to facilitate business, but chiefly to adorn the city. Among these may be named the Forum Nervæ or Forum Transitorium (so called because it was an important thoroughfare from the Carinæ and the Subura to the Forum Romanum), begun by Domitian and completed by Nerva; and, the most magnificent of all, the Forum Trajani, immediately adjoining the Forum Julium and Forum Augusti, and having connected with it the Basilica Ulpia and the famous Columna Trajani, still standing. The second class of fora was devoted to market transactions, and they derived their names from the articles sold in them—e. g. *forum olitorium*, the vegetable-market; *forum piscarium*, the fish-market; *forum boarium* (cattle), *forum suarium* (swine), etc. The word forum was applied (in the latter sense of a market, and also of a place at which the prætor held his circuit, administering justice) to villages or stations in the provinces of Italy (like the use of the term "court-house" in Virginia, from which grew up in time even flourishing towns; such were, among others less important, Forum Appii in Latium on the Appian Way; Forum Aurelii or Aurelium in Etruria; Forum Cornelii in Cispadane Gaul, now Imola; Forum Gallorum in Cisalpine Gaul, now Castel Franco; Forum Julii or Julium in Gallia Narbonensis, now Fréjus. See Jordan, *Topographie der Stadt Rom* (vol. i., part 2, p. 155 ff.), and Middleton, *Remains of Ancient Rome* (vol. i., p. 231 ff., and vol. ii. init.). Revised by G. L. HENDRICKSON.

Forum: in law, a court or judicial tribunal; a place where a remedy is sought. The Roman Forum was the place where the courts were held, and the name was, from this circumstance, introduced into the English law to denote a place of trial, and has been retained as a convenient designation in certain phrases until the present time. Thus the phrase *lex fori*, in which the term is most generally employed, means the law of a place or court where an action is instituted. (See LEX FORI.) *Forum contractus* is the court of the place where a contract is made. *Forum domicilii* is used to denote the court or place of a person's domicile; *forum rei sitæ*, the tribunal where the property in litigation is situated. There are various other important phrases in which the term is used, in all of which it has the same general meaning.

Forward, WALTER: lawyer and Congressman; b. in Connecticut in 1786, removed to Pittsburg, Pa., in 1803, and studied law, beginning its practice in 1806; began to edit *The Tree of Liberty*, a Democratic newspaper, at Pittsburg in 1805. He was M. C. from Pennsylvania in 1821–25. In 1824–28 he supported John Quincy Adams, and was thence identified with the Whig party. He was active in the convention of 1837 to revise the constitution of Pennsylvania; in Mar., 1841, was appointed first comptroller of the U. S. Treasury; was Secretary of the U. S. Treasury in 1841–43; in 1849–52 U. S. *chargé d'affaires* to Denmark, and then presiding judge of the district court of Allegheny co., Pa. D. at Pittsburg, Pa., Nov. 24, 1852.

Foscarari, fos-kaa-raa'ree, EGIDIO: ecclesiastic; b. at Bologna, Jan. 27, 1512; became a Dominican; in 1544 was made a prior and inquisitor at Bologna, and later Bishop of Modena. He was frugal, modest, and austere, and devoted much time and money to the poor and to the reclamation of the vicious classes. Paul V. imprisoned him for heresy, but Pius IV. vindicated him, and in 1561 he entered the Council of Trent, in which he assisted Forerius and Leonardo Marini in preparing the catechism and correcting the missal and breviary. D. at Rome, Dec. 23, 1564.

Foscari, fos'kaa-ree, FRANCESCO: Doge of Venice 1423–57; b. 1372; warred with the Duke of Milan in 1426 (peace concluded Apr. 26, 1433), 1438 (peace again Nov. 20, 1441), and 1452 (peace Apr. 9, 1454). The Venetians obtained possession of Cremona, Bergamo, and Brescia, but Foscari was deposed by the Council of Ten Oct. 23, 1457, and died Nov. 1, 1457. His sufferings and those of his son, banished as a traitor in 1445, are the subject of Byron's *Two Foscari*.

Foss, ARCHIBALD CAMPBELL: Methodist divine; b. at Phillipstown, Putnam co., N. Y., Mar. 6, 1830; graduated at Wesleyan University in 1852 with the highest honors of his class, and at once joined the New York Conference. He served several important churches, and in 1858 became associate pastor with Dr. John McClintock at St. Paul's, New York city. In 1860–62 he occupied the chair of Latin and Hebrew in his alma mater; from 1863 to 1866 was presiding elder of the Poughkeepsie district; in 1867 was offered, but declined, the professorship of Biblical Exegesis in the Drew Theological Seminary. In 1868, while preaching at Sing Sing, his health failed, and he traveled in Italy and Switzerland. D. at Clarens, Switzerland, Mar. 30, 1870.

Foss, CYRUS DAVID, D. D., LL. D.: b. at Kingston, N. Y., Jan. 17, 1834; a brother of Archibald C. Foss; graduated at Wesleyan University in 1854; taught mathematics in Amenia Seminary, N. Y., 1854–55, and was its principal 1856; entered the Methodist Episcopal ministry, and has held important pastorates, chiefly in New York and Brooklyn, 1859–74; was a delegate to the General Conference of his Church in 1872; became president of Wesleyan University, Middletown, Conn., 1875; elected bishop in Methodist Episcopal Church, May 12, 1880. He resides in Philadelphia.

Fos'sa Maria'na [Lat. *fossa*, ditch, canal, deriv. of *fo'dere*, dig + *Maria'na*, pertaining to *Marius*]: a canal about 16 miles in length, cut by the Roman general Marius from the river Rhône to the Gulf of Stomalenine, where it terminated at a port called Fossæ Marianæ, near the modern village of Foz. The work was done in 102 B. C., and traces of it existed in the fourth century. The entrance to the Rhône through the delta mouths being difficult and dangerous, Marius while encamped near by caused the canal to be dug by his army, thus diverting a large part of the river to a commodious entrance.

Revised by MANSFIELD MERRIMAN.

Fossil [from Lat. *fos'silis*, dug up, deriv. of *fo'dere*, *fos'sum*, dig]: the body or any known part or trace of an animal or plant buried by natural causes in the earth. The molds of shells, the impressions left by the feet of animals in walking, implements of stone or metal and other works of human art which have been accumulated naturally into rubbish-heaps, are thus strictly fossils. Perhaps the marks of rain, wind, waves, and shrinkage through heat should be included. Early writers believed fossils the result of certain laws of nature, and never animated; others suggested they might be relics of the Noachian deluge; but it is now generally conceded that they indicate the nature of the life of numerous successive periods in the earth's history from the *Eozoic*, or the *dawn* of life, to the latest vessel sunk in the chalky depths of the ocean. A few fossils have been preserved entire, like the elephants and rhinoceroses found encased in frozen mud and sand in Siberia. The relics are usually *petrified*, or rendered stony through the infiltration of mineral matter. The organic particles are slowly replaced through chemical forces by mineral atoms, but arranged in the same manner, so that the characteristic structure of the plant or animal is preserved. Microscopic sections show unmistakably the peculiar internal features of the pine, oak, or palm, though the substance is changed to flint. Fossils indicate the former existence of organic races now entirely extinct; that, as a whole, each successive period contained more highly organized structures than its predecessor; that tropical forms once flourished in the polar regions; that each epoch was characterized by peculiar groups. Hence formations are identified in new countries by means of fossils.

Fossil Botany: See PLANTS, FOSSIL.

Fossil Fishes: See VERTEBRATES, FOSSIL.

Fossil Footprints (*Ichnites*): impressions left by extinct animals in walking over mud and sand which has since hardened into stone. These may be made by various invertebrates or vertebrates, such as crustaceans, insects, batrachians, and reptiles, or even mammals. Few of this latter class are known, but among them may be mentioned those found at Carson City, Nev., probably made by some of the great ground-sloths (see MEGATHERIUM), but acquiring some notoriety through newspaper articles ascribing them to man. While tracks in stone must have been observed at an early date, the first scientific notice concerning them appears to have been by Dr. Duncan in the *Transactions* of the Royal Society, Edinburgh, in 1828. Trails, probably made by trilobites, and described under the name of *Climachtichnites*, are not uncommon in the middle Cambrian of New York, Wisconsin, and Canada; similar tracks appear in the Cambrian of Great Britain. Footprints of labyrinthodonts were described from the Trias of Germany under the name of *Cheirotherium barthii*, and very similar prints have been found in the Carboniferous of Pennsylvania and Kansas, the latter associated with tracks of reptiles. Prof. Marsh has described the footprint of an amphibian from the Devonian of Western Pennsylvania which is of special importance as being the sole indication of the existence of an air-breathing vertebrate at so early a date. By far the most important locality for fossil footprints is the valley of the Connecticut, where large numbers, representing a variety of species, have been found in the red Triassic sandstone so extensively quarried for building purposes. These were first noticed by Pliny Moody in 1800, and were described at length in 1836 by Prof. Edward Hitchcock, who based 153 species on these impressions, including birds, reptiles, batrachians, fishes, insects, and lower invertebrates. It is not probable that any of these tracks were made by birds, since no birds are known below the Jurassic, the so-called bird-tracks having been made by Dinosaurs. The Hitchcock Ichnological Museum of Amherst College, Massachusetts, contains more than 20,000 Ichnites, while the museum of Yale University has a still larger collection. F. A. LUCAS.

Fossil Forests: a popular name for collections of petrified tree-trunks. Few of these "forests" really deserve the name, as they generally consist of trees which have been carried far from their place of growth, buried in earth, there silicified, and subsequently exposed by the washing away of the material which once surrounded them. Among celebrated fossil forests there are those of Egypt near Cairo, of Nubia, of Silesia, and of the island of Antigua in the West Indies. Other accumulations of silicified wood occur in the interior of Chili, in New Zealand, and in Abyssinia, while in the U. S. there are as great and remarkable collections of silicified tree-trunks as any found in other parts of the world. On the banks of the Little Colorado, in Arizona, are silicified tree-trunks of all sizes up to 6 feet in diameter, perfectly and beautifully preserved, but none in positions or places occupied in life. Sometimes they are simply replaced by white silica, which shows the woody structure as distinctly as it could have been seen in the living tree; in other cases the trunks are masses of solid jasper, looking like huge sticks of red sealing-wax; in other cases still, the wood is opalized or agatized, or filled with chalcedony or crystallized quartz, stained with the most brilliant colors. In this region the history of the vast accumulation of silicified tree-trunks is easily read, and probably it will serve to explain many similar cases. The banks of the Little Colorado are formed of Triassic marls, here more than 1,000 feet in thickness. As the marls are very soft, they have been extensively eroded, leaving the silicified wood either on the surface—where trees 40 to 60 feet in length may often be seen, with all their parts in contact—or accumulated at the bottom of the slopes bordering the valleys from which the marls have been removed. Hot water has much greater power than cold to dissolve silica; and it is probable that thermal waters have had much to do with the silification of the tree-trunks in the localities where they are found in great numbers. In the U. S. volcanic phenomena have been displayed on a grand scale throughout all the region where fossil wood is found, and it is also a district in which thermal springs carrying large quantities of silica are numerous, and are still displaying their petrifying powers. There is reason to believe that in the later geological ages hot springs were even more abundant, and probably they were more potent than they now are. What is known of the geology of the island of Antigua is confirmatory of the view that thermal waters have played an important part in the silification of the fossil wood found there. In the Bad Lands of the Little Missouri thousands of silicified tree-trunks are scattered over the surface, where they have been exposed by the washing away of the sandstones and shales of the Laramie group, in which they were formerly buried.

A remarkable group of silicified trees, some of which are 12 feet in diameter, was discovered in Napa co., Cal., and is described by Prof. Marsh in the *Am. Jour. Sci.* (1871, p. 266); and a veritable fossil forest, in which the trees are standing erect, surrounded by volcanic *débris*, in large numbers and at several levels, is described by W. H. Holmes in his report on the geology of Yellowstone Park (Hayden's *Report* for 1878, p. 48).

In the drift deposits of Southern Ohio is found an old soil in many places thickly strewed with interlaced prostrate trunks of trees which grew upon it; and in a few cases these are found buried erect. This old forest was plainly submerged by the sinking of a land-surface or the elevation of the water-level over it, resulting in its burial beneath many feet of gravel and sand. The trees here are not mineralized, and have the appearance of partially decayed wood; but if the subsidence had been occasioned by volcanic action, and hot water had been poured out freely, undoubtedly the trunks would have been silicified, as they are at the Cascades of the Columbia river, where a volcanic outburst at a much later date buried quantities of trees and changed them to masses of silica. See PLANTS, FOSSIL. J. S. NEWBERRY.

Fossil Invertebrates: the remains of invertebrate animals found in stratified rocks, including the species of *Protozoa, Cœlenterata, Echinodermata, Vermes, Molluscoidea, Mollusca, Arthropoda*, and *Tunicata*. The fossil invertebrates already described and named reach a total of about 40,000 species. There are also probably 5,000 species of fossil plants, and of fossil vertebrates nearly 5,000 species. Upon fossil invertebrates therefore the science of paleontology is largely founded. The fossil invertebrates are also of great importance from a geological standpoint, because the majority of all the stratified rocks, upon which historical and formational geology are founded, were formed under the surface of the ocean, and the fossil remains preserved in them are mainly the remains of the invertebrates that lived along the shores in the ocean.

Some invertebrate remains, on account of their great abundance, constitute the basis of rock formations—e. g. limestones from corals and from crinoids, called therefore coral and crinoidal, or encrinital limestones. *Protozoa*, as in the case of the *Fusulina* of the Carboniferous, and the *Nummulites* of the Tertiary, form the main part of thick deposits; in the latter case reaching a thickness of several thousand feet; and the white chalk, so conspicuous on the two coasts of the English Channel, is composed of comminuted shells of other animals, but chiefly of the minute shells of Foraminifera. The abundance of fossils of one kind and another has suggested the names of Lingula flags, Graptolite shales, Pentamerus limestone, Productus, Coral Encrinital, Crinoidal, Cephalopod or Brachiopod limestone, and many others for the rocks containing them.

Invertebrate fossils are chiefly composed of the hard parts secreted when living by the animals which they represent. In the case of Gastropods, Cephalopods, Pteropods, and Lamellibranchs, they were the outer calcareous shells which protected the soft animal which secreted them. In the case of corals the secretion is also calcareous, but was made under, and at the base supporting the polyp, and lifting it from the bottom to which the coral was attached; the reef-forming corals continued to grow upward till large masses of the calcareous secretions were formed. Crinoids, Cystoids, Blastoids, and Echinoids are represented by calcareous coatings made up of polygonal plates inclosing in a cup or chest like body the more active soft organs of the animal. The breaking up, in part, and burying of the unbroken calcareous fossils of these kinds furnished the material of the limestones which in the aggregate reach a thickness of many thousand feet. The fossils of Brachiopods are both calcareous and chitinous, and were very perfectly preserved, often revealing the microscopic structure and the delicate internal supports for the brachia, after being fossilized for millions of years. The hard parts of Crustacea and Trilobites are the outside chitinous coverings of the animals, which, on account of their jointed nature and frailty after the animal is dead, are often broken and fragmentary.

On account of the presence of these fossils in the stratified rocks of the whole series from the base of the Cambrian upward, the paleontological history of organisms is read more fully respecting the invertebrates than respecting plants or vertebrates, the remains of which were preserved only rarely and under exceptional circumstances. The general discussion of fossil invertebrates, in their relations to the laws of organic history and as indicative of the characteristic life of the various geological ages, will therefore be found under PALEONTOLOGY. Remark is also made of some of the more interesting groups of fossil invertebrates under their generic, family, or ordinal names.

HENRY S. WILLIAMS.

Fossil Plants: plants or vegetable impressions preserved in the earth by natural agencies, such as inhumation, petrifaction, carbonization, or incrustation. See PLANTS, FOSSIL.

Fossil Vertebrates: See VERTEBRATES, FOSSIL.

Foster, BIRKET: landscape and genre painter; b. at North Shields, England, Feb. 4, 1825. Pupil of E. Landells, an engraver; member British Water-color Society. He painted principally in water-colors, and many of his pictures have been engraved. His work is very popular in Great Britain. He drew a great deal for illustration of books and periodicals. D. Mar. 27, 1899.

Foster, CHARLES: merchant and banker; b. near Tiffin, O., Apr. 12, 1828; received his education in the public schools, in the academy of Norwalk, Ohio, and under private tutors in what is now Fostoria, to which his father had removed; was engaged continuously for fifty-six years in mercantile and banking business: on the outbreak of the civil war was appointed colonel of the 101st Ohio Regiment, but was unable to accept; was elected to the 42d, 43d, 44th, and 45th Congresses; was a member of the committee and chairman of the sub-committee appointed in 1875 to inquire into political affairs in Louisiana; was elected Governor of his State in 1879, and re-elected in 1881; was appointed by President Harrison, in May, 1889, chairman of a commission to negotiate a treaty with Sioux Indians; received the votes of the Republican members of the Ohio Legislature in 1890 for U. S. Senator; was appointed Secretary of the Treasury by President Harrison, Feb. 7, 1891. C. H. THURBER.

Foster, Frank Hugh, Ph. D.: Congregationalist; b. at Springfield, Mass., June 18, 1851; graduated at Harvard College 1873; was Professor of Mathematics (1873–74) in the Naval Academy at Annapolis, Md.: pastor at North Reading, Mass., 1877–79; Professor of Philosophy at Middlebury College 1882–84, and was made Professor of Church History at Oberlin Theological Seminary in 1884. In 1893 he became Professor of Theology in the Pacific Theological Seminary, Oakland, Cal. He has published a translation of Grotius on the *Satisfaction of Christ.* He is one of the editors of *The Bibliotheca Sacra.* George P. Fisher.

Foster, George Eulas, D. C. L.: Canadian statesman; b. in Carlton County, New Brunswick, Sept. 3, 1847; graduated at the University of New Brunswick in 1868; studied at Edinburgh University and University of Heidelberg 1872–73; was principal of Victoria County Grammar School 1868–69; of Classical and Mathematical Baptist Academy, Fredericton, 1871; of Ladies' High School, same city, 1872: and was Professor of Classics and History in University of New Brunswick 1872–79. He was elected to the Canadian Parliament in 1882, and re-elected in 1887 and 1891. He was Minister of Marine and Fisheries 1885–88, and became Minister of Finance in 1888, a portfolio which he now (1893) holds. While Minister of Marine and Fisheries he discharged important departmental and diplomatic duties in relation to the Bering Sea and the Atlantic fisheries disputes with the U. S. In 1888 he attended the commission at Washington which resulted in the Bayard-Chamberlain treaty; in 1891 was one of the Canadian commissioners who visited Washington to confer with Mr. Blaine relative to improved trade relations between Canada and the U. S. Neil Macdonald.

Foster, Jedediah: judge; b. at Andover, Mass., Oct. 10, 1726; graduated at Harvard University 1744; practiced law at Brookfield, Mass.; was in the Worcester County convention Aug., 1774, and delegate to the Provincial Congress 1774–75; he was negatived as a counselor by the British general Gage in 1774, but re-elected in 1775; was judge of the superior court in 1776, then judge of probate, and a justice of the court of common pleas of Worcester co., Mass.; also a member of the convention which formed the constitution of Massachusetts. D. at Brookfield, Mass., Oct. 17, 1779.

Foster, John Gray: soldier and engineer; b. in Whitefield, Coos co., N. H., May 27, 1823; graduated at West Point July 1, 1846, and entered the U. S. army as second lieutenant of engineers. In the war with Mexico he served with a company of sappers and miners; engaged in construction of fortifications and on coast survey 1848–54; assistant Professor of Engineering at West Point 1855–57; as engineer in construction of Forts Sumter and Moultrie, South Carolina, and works in North Carolina 1857–61; chief engineer of fortifications of Charleston harbor, strengthening them to resist attack; in defense of Fort Sumter Dec., 1860, to Apr. 14, 1861; appointed brigadier-general of volunteers Oct., 1861, and commanded brigade on Gen. Burnside's expedition to North Carolina; appointed major-general of volunteers July, 1862, and assigned to command of department of North Carolina (Eighteenth Army-corps); conducted various expeditions; mustered out of volunteer service Sept., 1866; brevet brigadier and major general U. S. army Mar., 1865. Returning to duty with his corps he was placed in charge of works for the preservation and improvement of Boston harbor, and construction of defenses of Portsmouth harbor, N. H., and many other works of construction and repair; on location of West Shore Railroad at West Point, on Sutro Tunnel, Louisville and Portland Canal. Author of *Notes on Submarine Blasting in Boston Harbor.* D. Sept. 2, 1874. Revised by James Mercur.

Foster, John Watson: cabinet officer; b. in Pike co., Ind., Mar. 2, 1836; graduated at the State University of Indiana 1855; studied at Harvard Law School 1855–56; admitted to bar 1857; practiced law at Evansville till July, 1861, when he entered the Union army as major of the Twenty-fifth Indiana Volunteers; participated in the battles of Fort Donelson, Shiloh, Knoxville, and others; commanded cavalry brigade and division of Twenty-third Army-corps in East Tennessee campaign; appointed minister to Mexico by President Grant 1873; minister to Russia by President Hayes 1880; minister to Spain by President Arthur 1883; appointed on special mission to Spain by President Cleveland 1885; commissioned by President Harrison, 1891, to negotiate treaties of reciprocity with Spain, Germany, San Domingo, and other countries; appointed agent of the U. S. in the Bering Sea arbitration with Great Britain, June 1, 1892; appointed Secretary of State to succeed Mr. Blaine, June 29, 1892; in 1893 and 1897 visited Europe to represent the U. S. in the Bering Sea question; was adviser to Li Hung-chang in treating with the Japanese in 1895.

Foster, Judith Ellen: temperance advocate; b. at Lowell, Mass., Nov. 3, 1840; daughter of Jotham Horton; educated in Boston common schools, and Genesee Wesleyan Seminary, Lima, N. Y.; married E. C. Foster in 1869; studied law because her husband was a lawyer; admitted to the bar 1873; superintendent department legislation N. W. C. T. U. 1870–84; president Iowa W. C. T. U. 1886–91; president Nonpartisan W. C. T. U. of D. C. 1889–93; president Woman's Republican Association of the U. S. 1888. Author of *The Crime against Ireland*; *Amendment Manual* (Prohibition); *The American Renaissance*; *Republican Contentions and Supreme Court Decisions*; and transient articles on current reform and political questions.
C. H. Thurber.

Foster, Lafayette Sabine, LL. D.: statesman; b. at Franklin, Conn., Nov. 22, 1806. He was educated at Brown University, and graduated there in 1828 with the highest honors; studied law with the Hon. Calvin Goddard, of Norwich, and was admitted to the bar in 1831. Repeatedly elected to the General Assembly of Connecticut from Norwich, he served as Speaker in 1847, 1848, and 1854; mayor of Norwich in 1851 and in 1852, receiving on his last election every vote cast. He was U. S. Senator from Connecticut 1855–67, serving on various committees, and acting as chairman of committee on foreign relations during part of the civil war. In Mar., 1865, he was elected president *pro tem.* of the Senate. When Mr. Johnson, the Vice-President, became President by the death of Mr. Lincoln on Apr. 14, 1865, Mr. Foster became acting Vice-President of the U. S., and held that position for two years. In 1870 he was again member and Speaker of the Connecticut Assembly; judge of the Supreme Court of Connecticut 1870–76. D. at Norwich, Conn., Sept. 19, 1880.

Foster, Michael, M. A., M. D., F. R. S.: physiologist; b. at Huntingdon, England, Mar. 8, 1836; educated at University College, London; became Professor of Physiology there, and later prælector of physiology at Trinity College, Cambridge. He is now (1901) Professor of Physiology in the University of Cambridge and secretary of the Royal Society. His text-book of physiology (1876) has run through several editions.

Foster, Robert Verrell, D. D.: instructor and writer; b. near Lebanon, Tenn., Aug. 12, 1845; educated in the Cumberland University and Union Theological Seminary. He was for several years Professor of Mathematics in Mississippi, and in Waynesburg College, Pennsylvania. In 1877 he became Professor of Hebrew and Biblical Theology in the Theological Seminary at Lebanon, Tenn., combining with this, for several years, editorial work in the Cumberland Presbyterian publishing-house, and the work of Professor in the college for ladies in Lebanon. He has published *Introduction to the Study of Theology* (Chicago and New York, 1889); *Old Testament Studies, an Outline of Old Testament Theology* (Chicago and New York, 1890); *A Commentary on the Epistle to the Romans* (Nashvile, 1891).
Willis J. Beecher.

Foster, Stephen Collins: song composer; b. at Pittsburg, Pa., July 4, 1826; educated at Athens Academy and Jefferson College, Pennsylvania; taught himself music, French and German, and the elements of painting. His first published song was *Open thy Lattice, Love* (1842), and his last was *Beautiful Dreamer* (1864). Between these two he wrote nearly two hundred songs, in most instances both words and music, and many became exceedingly popular. Among them were *Nelly was a Lady*, *Old Dog Tray*, *Old Folks at Home*, (for which he received $15,000), and the serenade *Come where my Love lies Dreaming.* Foster's gift of melody was remarkable, and had he had a thorough musical education he might have become a second Schubert. D. in New York, Jan. 13, 1864.

Foster, Randolph Sinks, D. D.: Methodist bishop; b. at Williamsburg, O., Feb. 22, 1820; studied at Augusta College, Kentucky, and in 1837 entered the Methodist Episcopal ministry; held important stations in the Western States; was transferred in 1850 to the New York Conference; chosen in 1856 president of Northwestern University; in 1858 became a professor in Drew Theological Seminary; and in 1872 was elected a bishop; retired May, 1896. Author of *Objections to Calvinism as it is* (1849); *Christian Purity* (1851); etc.

Foster, Mrs. THEODOSIA TOLL, better known as **Faye Huntington**: a writer of books for children and older people; b. in Oneida Castle, N. Y., 1838; graduated at the Oneida Seminary (1860); engaged in teaching; principal of the Home School for Girls, Verona, N. Y. She has published the following volumes: *In Earnest* (1867); *Kittie Farnham's Letters* (1868); *Through Patience* (1869); *Allan Phillips* (1872); *Those Boys* (1874); *Mr. McKenzie's Answer* (1875); *Louise's Mistake* (1875); *Fred Robert's Start in Life* (1875); *Mrs. Deane's Way* (1875); *Ripley Parsonage* (1877); *Echoing and Re-echoing* (1878); *Susie's Opinions* (1883); *Millerton People* (1884); *Competitive Workmen* (1884); *Transformed* (1885); *St. Paul's Problem* (1889); *What Fide Remembers* (1887); *A Modern Exodus* (1891); *A Baker's Dozen* (1892). WILLIS J. BEECHER.

Fosto'ria: city and railway center; Seneca co., O. (for location of county, see map of Ohio, ref. 2–E); situated 35 miles S. by E. of Toledo. It has one of the largest flouring-mills in Ohio, glass-works, and numerous other manufacturing establishments, and is supplied with natural gas. Pop. (1880) 3,569; (1890) 7,070; (1900) 7,730. EDITOR OF "REVIEW."

Foucault, foo'kō', JEAN BERNARD LÉON: natural philosopher; b. in Paris, France, Sept. 18, 1819. In 1844 he invented an apparatus by which electric light is used in optical experiments, microscopic researches, etc.; in 1845 he became scientific editor of the *Journal des Débats*. He demonstrated the earth's rotary motion on its axis by the pendulum and gyroscope in 1851, was physicist to the Imperial Observatory (1854), and a member of the French Institute. In 1855 obtained the Copley medal of the Royal Society for measuring the velocity of light. D. in Paris, Feb. 11, 1868.

Foucault Currents (or *eddy currents*): in electricity, are currents named from FOUCAULT (*q. v.*), the French physicist. They are electric currents in the iron or other metallic parts of a dynamo, motor, or other machine, induced by the movement of the parts in question through a magnetic field, or by fluctuations in the field (as in the transformer, etc.). Within the masses of metal, closed circuits of low resistance are afforded, so that the currents generated are frequently of considerable magnitude. The energy thus produced being converted into thermal form is apt to result in injurious heating, to say nothing of the serious losses of work involved. Loss of energy through Foucault currents is prevented by lamination of the parts subjected to induction; layers of metal lying at right angles to the path of the induced currents being used, with insulating strips between them. See DYNAMO-ELECTRIC MACHINE, ELECTRICITY, INDUCTION, MAGNETISM, TRANSFORMER, etc.
E. L. NICHOLS.

Fouché, foo'shā', JOSEPH, Duke of Otranto: politician; b. May 29, 1763, in Nantes, France; member of the convention 1792, and voted for the death of Louis XVI.; infamous for his share with Collot d'Herbois in the butcheries at Lyons; Minister of Police 1799; dismissed by Napoleon, but recalled 1804; created Duke of Otranto 1806; again dismissed by Napoleon 1810; made by him governor of Illyria 1813, and Minister of Police for the third time on his return from Elba; head of the provisional government after second abdication of Napoleon; again made Minister of Police by Louis XVIII.; ambassador to Dresden 1815; exiled and deprived of office by the decree of Jan., 1816, against regicides. D. at Trieste, Dec. 25, 1820. His *Memoirs* (1828–29, 4 vols.) are spurious.

Fougères, foo'zhār': town of France; department of Ille-et-Vilaine, at the junction of the Nançon and the Coucsnon; 23 miles by rail N. of Vitré (see map of France, ref. 4–C). It is famous for its dyeing, especially of scarlet, whose delicate tints are due to certain qualities of the waters of the Nançon. It has also tanneries, granite quarries, and manufactures of sailcloth and shoemakers' supplies. Pop. (1896) 20,735.

Fou'la, fow'la: a solitary island in the Atlantic, belonging to the Shetland group; lat. 60° 9' N., lon. 2° 6' W. It is a granite block rising 1,369 feet above the sea, and inhabited by 250 persons, who carry on some fishing, farming, and hunting of wild fowls. It is supposed to be the ancient *Ultima Thule*.

Foulard, Fr. pron. foo'laar' [Fr. *foulard*; origin obscure]: a light fabric of silk, sometimes containing cotton, and used principally for ladies' dresses. It is chiefly of French manufacture, but a similar class of goods is largely made in Japan, India, etc.

Fould, foo, ACHILLE: statesman; b. in Paris, France, Oct. 31, 1800; of Hebrew parents; was in the Chamber of Deputies in 1842 and 1846, in the Constituent Assembly in 1848, and in July, 1849, was a member of the legislative body. Prince-President Louis Napoleon made him Minister of Finance Oct. 31, 1849, but he retired in Oct., 1851, filling the position, however, for a second period from Dec. 2, 1851, to Jan. 25, 1852; then made senator, Minister of State and of the House of the Emperor in 1852; commander of the Legion of Honor Dec. 8, 1852; then a third time Finance Minister from Nov. 12, 1861, to Jan. 1, 1867. D. near Tarbes, Oct. 5, 1867.

Foul in the Foot: a contagious disease of sheep, characterized by ulcers and granulations between the toes. Caustic and stimulant applications, such as oil of turpentine, followed by tarry applications, are generally curative. The cause and nature of this disease are not well understood.

Foulis, fowlz, ROBERT and ANDREW: printers; b. in Glasgow, Scotland—Robert, Apr. 30, 1707; Andrew, Nov. 23, 1712; Robert was a barber by profession and Andrew intended to enter the ministry, but in 1740 the former established a printing-press; three years later became printer to the University of Glasgow, and in 1743 the brothers entered into partnership. Andrew died Sept. 18, 1775, and Robert in 1776. They made fortunes by printing, and lost them in founding an academy of painting and sculpture in Glasgow, the paintings being sold by auction in 1776. Their editions of Greek and Latin classics, especially those of Homer and Horace, were noted for accuracy and elegance.

Foulke Fiord: See the Appendix.

Foulweather, Cape: See CAPE FOULWEATHER.

Foundation [from O. Fr. *fondation* : Ital. *fondazione* < Lat. *funda'tio*, deriv. of *funda're*, found, deriv. of *fundus*, bottom]: in law, in its most enlarged legal signification, the establishment of a corporation of any kind, and in which sense the sovereign or state is said to be the founder of all corporations, since their original creation is due to royal charter or legislative grant, express or implied. In its narrower, yet more usual and important, meaning, *foundation* refers to the establishment of eleemosynary or charitable corporations or institutions by private endowment; and it is sometimes, though less commonly, by a natural transfer of application, used to indicate the endowment itself. A large variety of charitable institutions have owed their origin and maintenance entirely to private munificence. There is vested at common law in the creator of such institutions the right to exercise a power of supervision over the management of the corporate revenues and the methods of corporate action and government. This is called "a power of visitation." Charitable purposes may also be accomplished without any corporate authority, through the medium of trustees appointed by the founder either by deed or will. These trusts are under the supervision of the courts of chancery. The same remark is applicable to the funds of charitable corporations, which may be called to account for a breach of trust. See the articles CORPORATION and TRUSTS.

Foundation: the substructure of a building; the lower courses upon which the whole superstructure rests. Its object is to furnish an unyielding base which shall preserve the building from unequal settling and consequent cracks and dislocations or ultimate collapse. The science of foundations is one of the most important branches of civil and architectural engineering, and presents many problems of great interest and frequently of great difficulty. The principles are simple, and may be briefly stated; their application has to be made under such varied conditions as to require in general a new solution for each problem. It is only possible in a short survey of the subject to state these general principles with some of their more common typical applications, explaining the methods and processes employed, and illustrating them by actual examples from buildings of several different kinds.

The construction of a foundation comprises the preparation of the *bed*—that is, of the bottom of the excavation; the laying of the *footings*, as the foundations proper or lower courses of the structure are called; and the building up of the *foundation walls* from the footings up to, or nearly to, the level of the ground, where the apparent or visible structure begins (sometimes called "neatwork" by engineers).

The general principle underlying these operations is that of securing a firm and incompressible surface or area on which to begin the construction of the building; and whenever the bed is of a yielding nature, or incapable of sustaining a heavy pressure, to so enlarge the base of the structure as to reduce the pressure per square foot well within the safe limit for the soil of the bed in question. It is consequently of the utmost importance to ascertain as thoroughly as possible beforehand the nature of the strata upon which the building is to rest, and for all heavy structures, such as chimneys and towers, bridge-piers and tall buildings, to determine the bearing-power of the stratum selected for the bed. It is far wiser, and often more economical, to spend a fair sum in borings and tests, and thereby to be enabled to proceed on a basis of definite knowledge, than to dispense with these and proceed upon assumptions which may prove costly mistakes in the end. In many cases, of course, the experience of adjacent buildings supplies the required information; in buildings of little height and light construction such precautions may be unnecessary, but it is certain that the cost of retrieving a single expensive blunder resulting from unexpected weaknesses in the foundation-bed or an unexpected depth to the surface of the rock would counterbalance the cost of experimental borings many times over.

Foundations may be divided into two general classes, those on incompressible soil and those on yielding or compressible soil. The latter class may be subdivided according to the nature of the soil, or according to the means employed to distribute the weight over the required increase of area. But it is not always easy to classify the soil by its common name. Hard rock is absolutely unyielding; so for most purposes is hard gravel, and so is sand when confined. But some rocks, partly disintegrated, are more yielding than hard clay; and sand, although incompressible when properly confined, is a most treacherous material when unconfined, especially when saturated with running water from springs or underground streams.

Foundations on Rock.—These require only that the rock-surface be dressed to roughly approximated planes normal to the line of pressure—i. e. horizontal for all vertical walls. A very gentle slope only requires roughening to prevent any sliding of the foundations upon it. Ordinary slopes should be cut into rough steps. But great differences in the depth of different parts of a foundation are to be avoided as far as possible, because of the greater settling in the masonry of the deeper foundations. The latter should be built up with cement-mortar and with careful masonry as close-jointed as possible; or concrete may be employed to make up the difference in height, since concrete, when once fairly "set," is incompressible, like the rock itself. Care should be taken to fill up all crevices and fissures in the rock-bed with cement or concrete, or to arch over such as are very deep and wide. The bed should also be carefully drained to prevent injury to the foundations themselves from surface-water or adjacent springs, and all disintegrated and soft rock removed. Upon a rock-bed so prepared the masonry may be built up without any great "spread" or increase of breadth at the base. The footings are usually, though not always, composed of large stones, and the chief precaution requisite in the foundation-walls is to see that they are thoroughly bonded by the use of "headers," and that they are laid up with a good quality of mortar, preferably cement-mortar. When the rock "gives out" under a building site, the builder has a very difficult problem to face. It becomes necessary to found a part of the edifice on a more or less compressible soil, and some settling is almost sure to occur over those portions of the foundation in spite of every precaution. Sometimes, however, an apparent failure of the rock indicates merely a more or less sudden dip or falling away of the ledge, which may be reached again by simply digging deeper. In such cases the difference in the depth of the excavation should be made up, as already indicated, by solid concrete, or by closely built masonry laid up in cement, or by concrete "piles" or "wells," as described farther on.

Foundations on Hard Gravel.—Hard gravel is an excellent material for a foundation-bed, and may safely be relied upon to bear a pressure of 5,000 lb. per square foot. Where it overlies rock, and is not liable to scour from running water, it will often safely sustain a greater load than this, Rankine's allowance of 1 to 1·5 tons (long) being undoubtedly much too low. The chief precautions to observe in founding on gravel, after it has been excavated to below the frost-line (2 to 6 feet, according to climate), are to drain the trenches thoroughly, and to secure as nearly equal a bearing as possible upon all parts of the trench. The footings are usually of concrete or of large stones, as nearly flat as possible, presenting a wide bearing-surface and a deep bond into the wall. Sometimes the bottom of the trench is covered with a layer a few inches thick of broken stone, on which the footing-stones are laid. The footings are sometimes laid up "dry"—i. e. without mortar—in such cases they should be laid with extra care, and thoroughly wedged to prevent movement under the superimposed weight. If laid in mortar, strong cement should be used. Concrete footings are made in layers 9 to 18 inches thick at a time, thoroughly rammed, and allowed to "set" before the addition of the next layer. It is customary to "spread" the footings, making them 50 per cent. wider than the walls to be built upon them (Fig. 1). It is important to confine the concrete, either by temporary walls or molds of planking, or, better still, by filling with it the whole width of the trench, until it has thoroughly set. Otherwise it is apt to spread and disintegrate under its own weight while soft, and to set in a less compact and solid mass than when so confined. The figure shows the trench filled with concrete on which are the stepped or spreading footings.

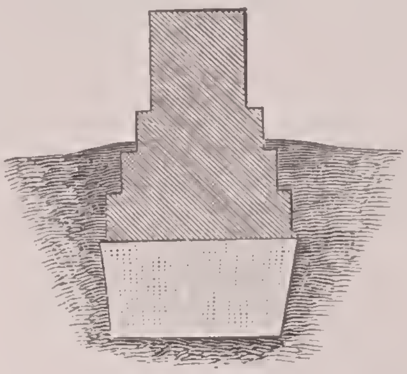


FIG. 1.—Section of concrete footings, etc.

Foundations on Sand.—Sharp sand, constantly dry or wet, is practically incompressible when properly confined so as to prevent lateral movement. When foundations are to be laid in sand it is necessary to excavate below the frost-line, ordinarily from 4 to 6 feet, and to drain the trenches thoroughly when there is any danger from springs or infiltration of water. Light buildings may be erected upon footings of large stones, preferably flat, laid dry in the trenches; sometimes a layer of broken stone 6 or 8 inches thick is first spread over the bottom of the trench, though the utility of this practice is questionable except as a drain under the masonry. The footings should be carefully laid, with a spread of 50 per cent. over the thickness of the walls, and should cover as nearly as possible the whole bottom of the trench, cut to the requisite width with this end in view. The chief danger is that the more heavily weighted parts of the masonry may settle by forcing up the sand under other less heavily loaded portions. It is consequently important to secure an approximately equal distribution of the pressure over the whole bed by the use of a platform or continuous footing of timber or concrete. Such platforms of timber, called "grillages" when used on a large scale, will be described later. Concrete footings are laid as already described for foundations on gravel. For heavy structures, however, the danger of lateral yielding of the sand requires to be guarded against, especially on sloping sites and under retaining-walls. This is accomplished sometimes by the use of parallel brick walls

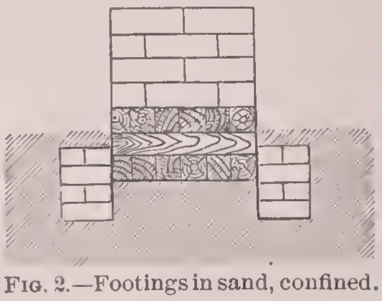


FIG. 2.—Footings in sand, confined.

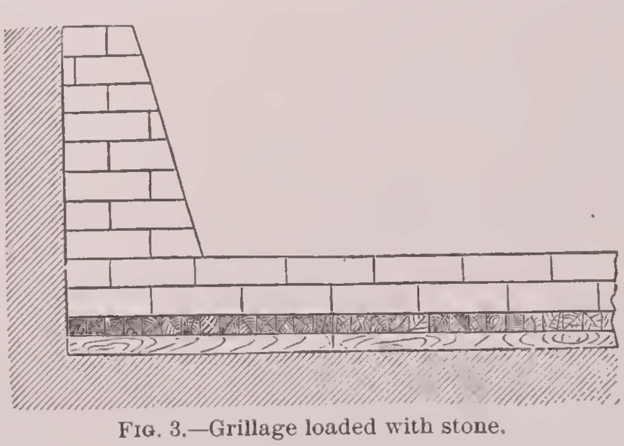


FIG. 3.—Grillage loaded with stone.

on either side of the trench, penetrating 2 or 3 feet below its bottom (Fig. 2), and laid up in cement. Quite as efficient and less expensive is the employment of *sheet piling*. This consists of planks driven vertically close together, edge to edge, into the ground to the desired depth, and spiked at the top to string-pieces of timber. To resist the upheaval of sandy soils outside of retaining-walls, as in the case of fortifications, a timber platform or "grillage" may be extended some distance beyond the wall and loaded with masonry (Fig. 3), or an inverted arch may be constructed abutting externally beneath another wall or other load, as shown in Fig. 4.

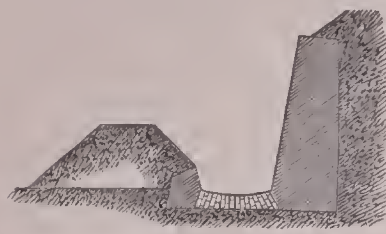


Fig. 4.—Inverted arch in trench.

Foundations on Quicksand.—The most treacherous of all beds, however, is quicksand, or sand permeated by moving water. Though belonging properly in the category of compressible soils it will be treated here for the sake of convenience. The whole site of the building should be surrounded by sheet piling, and the structure erected on a platform of concrete extending under its whole area. Sometimes a grillage of heavy timbers—i. e. a platform of logs or squared timbers laid in successive courses crossing at right angles and bolted together—is first laid over the area excavated, and the voids filled up with concrete. In either case the water must be carefully excluded while the concrete is setting, lest it wash out and disintegrate the concrete before it has had a chance to harden. To this end the water is drained into a trench or well, and pumped out continually until the concrete is firm and solid. The footings and foundation-walls must in such cases be laid up in strong hydraulic cement, and be protected externally against the percolation of the water by a liberal coating of asphalt or tar. Unless this precaution be taken infiltration is sure to take place. Subterraneous springs in the foundation-bed have been known to break through concrete 2 feet thick, and if confined or plugged at one point, to burst through at some other point. In building the foundations of the great dry dock in the Brooklyn navy-yard this difficulty was met with, and the engineer, J. W. McAlpine, finally overcame it only by driving two tiers of piles, one over the other, in a space of 1,000 sq. feet around the spring, and laying upon these a heavy floor of brick and cement, with vent holes to allow the escape of the troublesome spring (1841–51). The foundation of a water-works pumping-station at Clear Stream, near Jamaica, L. I., designed by the writer, consisted of an "area" or platform of concrete 2 feet thick under the whole building, with another independent platform for the chimney. The whole region overlies a subterranean stream of fresh water flowing through the sand 18 inches below the surface, and the excavation was fairly honeycombed with springs. These were drained into a trench, and pumped into a neighboring brook; but the flow of water through the sand underlying the platform carried with it so much sand that before the masonry of the walls was fairly begun the whole platform had settled from 2 inches at the end farthest from the pump to 5 inches at the end nearest to it. "Flowing" sand must be treated precisely as though it were water, and indeed in many cases the simplest and safest solution of the problem it presents is to excavate through it to solid bottom or to use piles reaching to a firm soil beneath it.

Foundations on Compressible Soils.—The means employed to prepare foundations on compressible soils divide themselves into two general classes—*pile foundations* which provide support by means of a multitude of rigid piers or posts penetrating through the soft stratum, and *platform foundations* which distribute the superincumbent load over an area sufficient to reduce the pressure per square foot within the safe limit for the soil in question. This safe limit or bearing-power can only be accurately determined by actual tests, and these should always be resorted to in the case of all important and heavy structures. The tables given by Rankine and other authorities can only be treated as rough approximations, not to be relied on in special cases, owing to the wide range of strength in soils apparently of the same class.

Pile foundations are of two principal kinds, "sand piles" and rigid piles made of wood or iron. To these may be added a species of pile sometimes used under special conditions and termed "concrete piling." These will be taken up in the above order.

Sand Piles.—In soft or boggy soils where the moisture is not sufficient to cause the sand to work into the surrounding earth, sand piling may be advantageously used. Holes are bored in the bottom of the trench, 6 or 8 inches in diameter, and 6 feet deep or thereabout, and filled with damp sand well rammed. The sand distributes the vertical pressure of the load equally in every direction, laterally as well as vertically, instead of downward only, as is the case with wooden piles. It is not therefore necessary to penetrate to a solid bearing, the important element being the amount of lateral surface presented by the piles. These should be spaced farther apart than wooden piles, and care be taken to prevent upheaval of the soil between them. This may be done by laying a solid platform of wood or concrete over the whole bottom of the trench.

Timber Piling.—The principle involved in wooden piling is entirely different from the above. The function of a wooden pile is either (*a*) to transfer the downward pressure of its load directly to a stratum capable of bearing it, by penetrating through the softer overlying strata, or (*b*) to support its load by the friction of its lateral surface against the soil. It is commonly considered that a friction pile will safely bear one-fifth the safe load of a pile driven to a solid bearing. Yet the experience of certain railway engineers in the U. S. tends to show that this is much too low an estimate of the relative supporting power of friction piles, as will be shown later. Piles are usually round, from 8 to 18 inches in diameter, and 20 to 35 or 40 feet long, or even longer. They should be of straight timber, free from knots and flaws, and should be driven with the bark on when used in tide-water or wet soils. Pine is the material most commonly used in the U. S., white pine in the North, and the long-leaved yellow pine in the South. Oak is also used in some localities, though it can not be obtained in such lengths of straight timber as can pine. Cypress, spruce, chestnut, and other woods are also sometimes employed. The piles are driven with the small end downward; this end should be tapered for 2 or 3 feet to a diameter of 5 or 6 inches and cut off square, as it is then less likely to be deflected by bowlders or other obstacles. When it is required to penetrate very stiff clay or marl, the small end may be shod with an iron "shoe" (Fig. 5) to prevent splitting or "brooming." The upper end or "butt" should also be cut off square and bound with a heavy wrought-iron ring. For heavy work all these preparations should be executed with particular care. Piles are driven in rows by the use of a "pile-driver," having vertical guides in which slides a hammer or weight of iron, weighing from 1,000 to 3,000 or 4,000 lb., hoisted by a cable and winding-engine, and released at any convenient height either automatically or by hand, the whole pile-driver and engine being moved along on rollers or floated over the water to the position of each successive pile. The spacing of the rows of piles and of the piles in each row is regulated by the width and weight of the superstructure. Thus if each pile is to be allowed a weight of 15 tons, two rows 3 feet apart, with piles spaced $2\frac{1}{2}$ feet in each row, would be required to support a wall 3 feet thick at the base, and weighing, with its share of the floors and roof fully loaded, 12 tons to the running foot. When the piles have been driven to the requisite depth, they are cut off to a level, and the footing-stones laid directly upon them (as is done for light and ordinary work), or upon heavy stringers bolted to the head or butt of each pile. Sometimes a solid platform of heavy timbers or planking is built upon the piles, on which the masonry is set; in some cases also a filling of concrete between the heads of the piles takes the place of the platform.

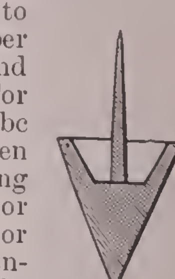


Fig. 5.—Iron shoe for pile.

Fig. 6 illustrates the construction of the sea-wall adopted and in part carried out along the North river front of New York city, showing the use of piles where the rock bottom is too deep to allow of excavating to it. The piles are driven to a solid bearing and cut off 15 feet below low water, and upon them is laid a timber platform which carries the masonry of granite facing and concrete backing.

Various formulas have been devised for determining the loads to be safely borne by piles under different conditions. For piles driven to a solid bearing, Rankine allows 1,000 lb. per square inch of head-surface. This would give somewhat over 108,000 lb. for a 12-inch pile, and 243,000 for an

18-inch pile. Patton says (*Practical Treatise on Foundations*, New York, 1893), "In sand and gravel piles will carry to the full extent of the crushing strength of the timber, provided the depth in the material is sufficiently great to prevent vibrations" (as from passing trains in the case of a bridge) "from reaching the point of a pile." If this be true of piles driven in sand and gravel, it must be true *a fortiori* of piles driven to a solid bearing, and Rankine's allowance may be safely exceeded. But this supposes the material penetrated to be sufficiently compact to prevent rocking or tipping of the piles. The partial collapse of the bridge at Tours, France, built in the eighteenth century, is to be attributed to the tipping of the piles driven down to rock-bottom, as shown in Fig. 7. This bridge of fifteen arches, each of 75 feet span, is a splendid example of French bridge-building in every respect, except the insufficient stability of its pile foundations, which required to be underpinned and, in some cases, filled in or "injected" with concrete.

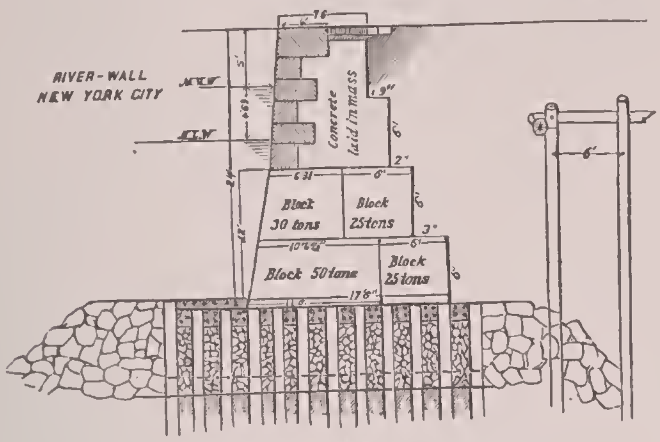


Fig. 6.—Foundations of sea-wall, New York.

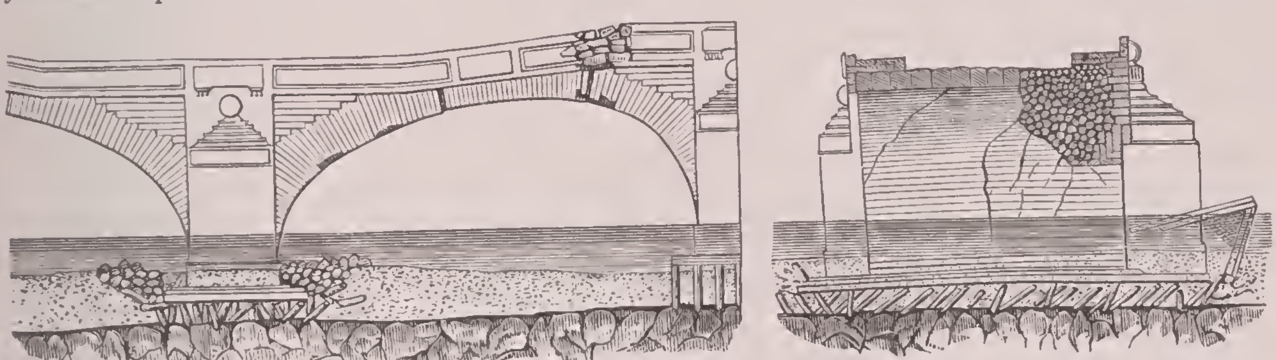


Fig. 7.—Bridge at Tours.

The formulas in use for the safe load on piles driven through more or less yielding strata are based upon the amount of penetration of the pile under a given impact, as of a hammer of given weight dropped from a given height. Rankine's formula, far too complicated for practical use, is

$$P = \sqrt{\frac{4ESWh}{l} + \frac{4E^2S^2x^2}{l^2}} - \frac{2ESx}{l}, \qquad (1)$$

in which $P=$ extreme load on pile in tons; E a constant modulus of elasticity $= 108{,}000$ feet per square foot; $S=$ sectional area of pile in inches; $W=$ weight of hammer, h its height of fall in feet; x the penetration of the pile at last blow; and l its length in feet. The same notation will be employed for the other formulas.

Sanders's formula is

$$P = \frac{Wh}{8x}, \qquad (2)$$

the height of the fall being in this case taken in inches, and P being the *safe* load in *pounds* instead of the extreme load in tons on the pile.

Trautwine gives the following:

$$P = \frac{\sqrt[3]{h} \times W \times 0{\cdot}0268}{1+x}, \text{ or, in simpler form,}$$

$$P = \frac{0{\cdot}0268\, W \sqrt[3]{h}}{1+x}, \qquad (3)$$

in which P is the extreme load in tons, which should be divided by a factor of safety of from 2 to 4; and h is taken in feet, not inches. McAlpine's rule is

$$P = \frac{80}{3}\left(W + 0{\cdot}0228\sqrt{\frac{h}{12}} - 1\right), \qquad (4)$$

h being in this case measured in inches. Assuming a pile to sink half an inch under a 1,000-lb. hammer falling 8 feet, Sander's formula allows 24,000 lb. as the safe load on the pile; Trautwine's rule, 30,600 lb. with a factor of safety of 2, or 20,400 lb. with a factor of 3; and McAlpine's rule, based on experiments in laying the foundations of the Brooklyn dry dock already mentioned, 26,640 lb.

The above formulas, proceeding upon the theory that the penetration of a pile under a given impact measures precisely the resistance of the soil reached at the given blow, determine the safe load to be allowed each pile without regard to its being driven "home" or to an absolute or approximate stoppage. But as no one can tell into what sort of stratum the next blow might drive the pile, and as piles often enter a treacherous soil after penetrating a more solid one, there have arisen various rules for determining when a pile has been driven "home." Thus the French engineers are accustomed to regard a pile as fully driven when it sinks one-fifth of an inch under thirty blows of an 800-lb. hammer falling 5 feet. Another rule commonly given is to consider the driving completed when the pile sinks one-quarter of an inch under a single blow of a 2,500-lb. hammer falling 30 feet. For ordinary work, however, where the pile is to be loaded much under the safe limit allowed by the formula used, considerably more sinking than the above may be permitted. Indeed, the value of all these rules and formulas is seriously questioned by some eminent practitioners. Prof. Patton (*op. cit.*, pp. 210–222) demonstrates from a wide experience in railroad bridge-building the superiority of actual tests over all formulas, and the unreliability of many of the data on which these formulas are based. Thus apparent "sinkage at the last blow" may be due solely to the crushing and brooming of the butt of the pile; often a pile allowed to "rest" a while is found to offer a resistance to sinkage many times greater than when last struck; and piles which are very far from being driven "home" will support by frictional resistance a load much greater than the rules will allow. In swampy and alluvial lands this comforting fact is of great practical value, and conduces to a great saving of expense.

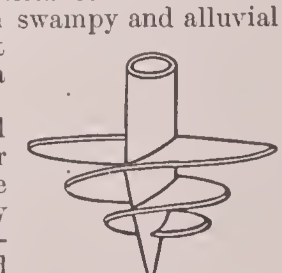


Fig. 8.—Screw pile.

Screw piles (Fig. 8) have been used in many cases to secure a broader bearing in soft strata. They are made of metal and driven by turning. They have proved especially useful in maritime works, as for lighthouses and wharves. Disk piles, having broad flanges at the base (Fig. 9), have also been used successfully in India especially for bridge-work. For a description of a screw-pile bridge across the Mobile river, see Patton's *Practical Treatise on Foundations*, article lii.

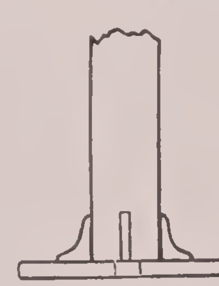


Fig. 9.—Disk pile.

Piles completely buried in sand or in water may last for centuries. The cities of Venice and Amsterdam are conspicuous examples of the durability of pile foundations. The Back Bay region of Boston, Mass., built upon made land—i. e. land artificially filled in—rests wholly upon pile foundations. The chief danger of decay results from exposure alternately to water and air, as in the case of tide-water wharves. In soils saturated by the fluctuating tide the piles should be cut off below the low-water level.

Concrete Piling.—In soft soils overlying rock or hard gravel, which may be reached at no great depth, foundations are sometimes constructed, especially in France and Germany, by boring holes from 28 to 36 inches in diameter to the solid substratum, and filling these with concrete. In this way there are formed isolated piers, spaced 6 to 12 feet on centers, and connected by arches of masonry, or by metal girders, upon which the walls are built up. Such concrete piles or "wells" require particular care in the compounding of the concrete, and in its being thoroughly rammed in layers not over 18 inches to 2 feet thick. The wide spacing of the piers subjects each one to a heavy load, with no help from its neighbors in case of failure or settling from any cause. Such piers should rest on a solid stratum, as the proportion of frictional area to load is so small (in comparison with wooden piles) as to offer little resistance to sinkage. A conspicuous example of this sort of foundation is the great votive Church of the Sacred Heart at Montmartre, Paris, which stands on a treacherous soil of clay and sand of varying depth, over the substratum of gypsum which underlies the whole city. See *Architectural Record*, vol. iii., No. 1.

PLATFORM FOUNDATIONS.—The function of the platform, whether of timber, concrete, or other material, is to distribute the pressure over a wider area than that of the foundation walls themselves, and at the same time as far as possible to prevent any one portion of the building from settling more than another part. Platforms are of four principal kinds: those of concrete, of masonry, of timber, and of iron and concrete; these will be considered in this order.

Concrete Platforms.—Concrete, already so frequently alluded to, is an artificial material consisting of broken or crushed stone or coarse gravel, consolidated by a mortar of hydraulic cement mixed with sand and water in definite proportions, varying with the requirements of each case. A common rule is to use one barrel of Portland cement to three of damp, loose sand and five of broken stone; or where greater strength is required these proportions may be made one, two, and four respectively. Great care is required in supervising the measuring, mixing, and depositing of the concrete, but a full discussion of the subject is out of place here. (For details, consult Gen. Q. A. Gillmore's *Limes, Hydraulic Cements, and Mortars* (New York, 1872); Patton's *Practical Treatise on Foundations*, pp. 9–23; also articles CONCRETE and MASONRY.) To establish a concrete platform the excavation is made over the required area and to the necessary depth, always below the frost-line, and the bottom brought to a level. The concrete, mixed close to the place of its using, is dumped from the barrows where required, spread evenly in layers of from 9 to 12 or 18 inches thickness, and thoroughly rammed. Each layer is allowed to set, and its surface is then picked to afford a "key" for the next stratum of concrete to hold by, and thoroughly sprinkled before the next layer is applied.

Concrete platforms or "areas" are used under structures of limited area but considerable height and weight, such as towers, chimneys, and bridge-piers, and under large buildings having many piers, the spread of whose footings leaves comparatively narrow spaces between them. Such a platform consolidates the whole structure into a unit, and settlement of one portion of it apart from the rest becomes impossible except by the breaking or crushing of the concrete itself. Concrete platforms are also useful where buildings are to be erected on quick or springy sands, and on wet soils where it is necessary to exclude water from the basement or cellar of the building, as already illustrated in the case of the pumping-station near Jamaica, L. I., already alluded to.

Masonry Platforms.—The only way in which masonry of brick or stone can be employed for platform foundations is by the use of inverted arches. When in a building subjected to heavy loads isolated piers are substituted for continuous walls, as is practically the case in the modern American system of "post-and-girder" construction, even when the exterior walls are apparently continuous, two methods of providing a foundation are available. One is the method of "isolated foundations," to be described later; the other is that of the continuous platform, of which the concrete platform just described is but a special case. In such buildings the turning of a series of inverted arches between the several piers secures a continuous pressure upon the continuous footing under each line of piers. By turning inverted barrel-vaults between each line of inverted arches, the various loads are distributed over the whole area of the building, as by a concrete platform or grillage (Fig. 10). All the arches and vaults should be calculated precisely as if they were ordinary upright arches with a distributed load equal to that on the piers they connect, since the total reaction upward against the arch is equal to the total load, and is equally distributed over all its surface. Such arches should be of segmental curvature, and laid in cement mortar with even greater care than if they were visible parts of the superstructure.

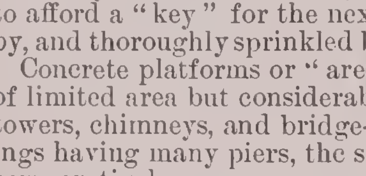


FIG. 10.—Inverted arches.

Inverted arches are, however, oftener used to distribute the weight of rows of piers over the longitudinal footings than to form actual platforms over a whole area.

Timber Platforms.—Another method of establishing a wide bearing-area on which to construct the masonry of the superstructure is by the use of what is commonly called a grillage, composed of timber, either squared or in the log. When laid in a constantly wet soil, or completely buried in sand, the timber is practically indestructible. A ship of the Viking period (tenth or eleventh century), excavated in Norway in 1875, was found to be perfectly sound after its burial of over eight centuries. When employed under isolated walls the pieces of timber, in the form of 3-inch planks or of 4 by 6 inch stuff, are laid across the trench in close order, and longitudinal stringpieces spiked to them. Where considerable spread is required under heavy structures, as in the case of a chimney or bridge-pier, or of a grillage under a whole building, the timber is laid in several successive layers, the pieces of each layer crossing the one below at right angles, and the whole securely bolted through together. When laid with interstices between the pieces of each layer, it becomes necessary to lay over the topmost timbers a heavy planking on which the footings are begun; the hollow spaces being also filled up, as the construction of the grillage progresses, with sand, or, still better, with concrete. The whole platform should be completely buried after the completion of the foundation walls. The successive layers above the two or three lowest are often diminished in size up to the footings of piers or walls.

Timber grillages have been frequently used for foundations both of bridge-piers and of tall buildings. The New Orleans custom-house (built 1848–1860) stands upon a timber grillage laid on a plank flooring 7 feet below the street-level. The soil is exceedingly soft and treacherous—a sandy clay saturated with water—and firm bottom can not be reached except at an excessive depth, so that even piling is not to be trusted. The grillage consists of logs 12 inches in diameter laid in close contact, and crossed by a second layer of similar logs 3 feet apart. The interstices are filled with concrete, and the whole grillage covered with a 12-inch layer of the same material. The building settled gradually during its construction, some 2 feet in all, the settlement diminishing from year to year, but the settlement was unequal in different parts of the building. The Auditorium Building of Chicago, a ten-story building covering over 60,000 square feet, with a tower 240 feet high, rests upon a grillage 24 inches thick, over which is a concrete platform 5 feet thick, in which are imbedded three layers of steel rails, one layer of 15-inch V-beams, and one of 12-inch I-beams, securing a perfect distribution of the load over the whole platform.

Platforms of Iron and Concrete.—A system of foundations somewhat similar to the above has come into quite general use in the U. S., having been employed with success in Chicago, where the soil is soft and treacherous, a wet clay overlying quicksand (as is generally supposed), with no solid bearing short of 50 or 60 feet deep. This great depth has generally forbidden the use of piles, although there are engineers who, distrusting the results of test-borings, claim that the soft soil covers a heavy bed of compact clay over hard gravel, which should carry heavily loaded piles with safety. By the Chicago system the bearings are spread by means of platforms, either of grillage or of concrete, to an area which reduces the pressure to between 3,000 and 4,500 lb. per square foot. Upon the concrete base are piled two or three layers of steel rails (70 to 75 lb. to the yard) laid close together, the layers crossing each other at right angles, and topped off with 15-inch (up to 20-inch) I-beams, on which the masonry or the iron column rests. The whole is buried in concrete, and the sides plastered heavily with cement to protect the ends of the beams. Such foundations, although somewhat more expensive to construct than if built up in dimension-stone from the concrete base or footing, are more economical in the end. Figs. 11 and 12 give sectional views of the two systems for comparison. It will be seen that the dimension-stone footings in Fig. 12 occupy much valuable space above the cellar-floor unless the excavation be made much deeper than that shown in Fig. 11, where the whole foundation lies beneath this level. There is, furthermore, a considerable saving of weight in the foundations themselves. The weight of the masonry footings in Fig. 12 is nearly twice that of the steel and concrete in Fig. 11. This saving would allow the addition of another story without exceeding the load on the bed in Fig. 11.

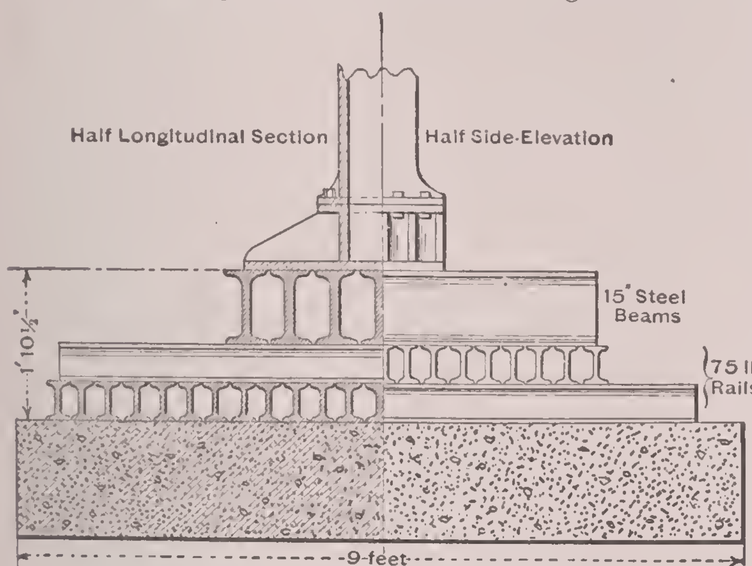


FIG. 11.—Iron-rail footings in concrete.

Such foundations as these may be laid either on a continuous platform or "area" of concrete or on a grillage, or they may be set on independent platforms, each specially proportioned to the particular load it bears. This last is the common practice in Chicago, where the problem of foundations for high buildings in cities has received particular attention. There is nothing essentially novel in the system itself, which in an elementary form is asserted to have been employed by the Byzantine engineer and architect Anthemius as early as 532 A. D. in building the Church of the Divine Wisdom, now the mosque of Santa Sophia, so called. To the Chicago builders belongs, however, much

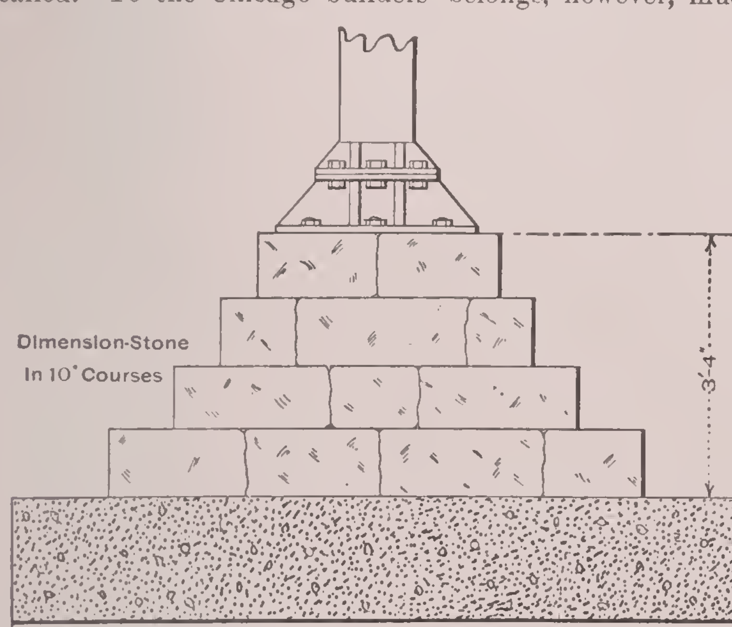


FIG. 12.—Masonry footings in concrete.

of the credit for the reduction of the principles involved to a scientific basis, and for the special methods adopted, especially the use of metal rails and beams with concrete as above explained. See Patton's *Practical Treatise*, pp. 343–347; also *Engineering News* for Aug. 8, 1891; article by C. T. Purdy, C. E.

In all these various platform systems the basis of computation of the required area is of course the bearing-power of the soil of the foundation-bed. This bearing-power is best determined by actual experiment, and it is obviously important that the safe load allowed be kept well below the extreme limit derived from the experiments. It does, indeed, not infrequently happen that as the building progresses, the increased weight, although causing the foundation to settle somewhat, by compressing the soil gradually increases its bearing-power until an equilibrium is reached and the settling ceases. This is especially likely to happen when the soil under the foundations is confined by sheet piling; but it should not be relied upon for sustaining loads in excess of the observed bearing-power of the soil except as the result of careful experimental tests. It is always a wise precaution, moreover, to load the foundation, when built on soft and compressible soils, with a load equivalent to that which it must ultimately bear, removing the load in proportion as the work advances. This hastens the total settling of the foundations and the final reaching of a stable equilibrium before the walls are built up, so that when once completed there is less likelihood of deformation of string-courses and twisting of floors. This precaution was successfully applied in building the Auditorium tower in Chicago.

Rankine gives in *Rules and Tables* the following safe loads on different soils:

Moderately hard rock...........	9 tons per sq. foot;
Rock of the strength of good concrete........................	3 " " "
Soft rock........................	1·8 " " "
Firm earth, dry gravel, hard clay, confined sharp sand.........	1 to 1·5 tons per sq. foot,

the ton being taken at 2,240 lb. The progress of engineering experience has, however, shown these figures to be, in general, too low, although the great variation in the strength of different soils of the same kind under varying conditions may sometimes reduce the safe allowance to Rankine's limits. Moreover, the terms "soft rock," "firm earth," and the like are somewhat too vague for precise calculations. A few cases from actual experience will prove instructive. The towers of the suspension bridge over the Ohio at Cincinnati are 242 feet high above the foundation. The tower on the Cincinnati side rests on a bed of compact gravel, which has successfully borne the pressure of over 10,000 lb. per square foot exerted by the tower—from three to four and a half times Rankine's allowance. The Roquefavour aqueduct in France stands upon hard rock, which carries a load of 26,800 lb. per square foot. The foundation-bed of the Gorai bridge in India is composed of close sand, and supports 16,000 to 18,000 lb. per square foot. On the other hand, in the bridge at Nantes, France, some settlement has already taken place with a pressure of 15,200 lb. per square foot on sand, and there are plenty of cases on record of settlements and dislocations of a serious character occurring in buildings founded on soils nominally and apparently of the same class with others in which much heavier loads have been borne without yielding. Much depends upon the underlying strata, on the presence or absence of "scour" from springs or running water, upon the weathering of the denuded rock, and much upon the workmanship of the foundations themselves. Hence the danger of hasty generalizations and the necessity of careful tests and experiments wherever the conditions are not absolutely known. A few further examples of weights actually borne may be not out of place here: At Coney Island a stick 12 inches square bore without sinking perceptibly in the micaceous sand a load of 10 tons. Under certain parts of the East river bridge (New York and Brooklyn) the sand carries a load of $6\frac{3}{4}$ tons. The Washington Monument, the tallest existing structure of masonry, exerts a pressure of 10,000 lb. per square foot on a bed of mixed clay and sand; it is estimated that this pressure is sometimes doubled on the leeward side in high winds. The new bridge across the Firth of Forth, Scotland, loads its foundation-bed of silty sand up to $3\frac{1}{2}$ tons per square foot. During its construction the foundations were loaded with extra weights up to $5\frac{1}{2}$ tons, with a resultant settling of $1\frac{1}{4}$ to $1\frac{3}{4}$ inches. The load on the foundations of the Eiffel Tower, Paris, was about 3 tons per square foot.

FOUNDATIONS UNDER WATER.—These constitute a wholly distinct class of problems from those hitherto considered, and involve in general much more elaborate preliminary operations, on account of the difficulty of excluding the water while the bed is being prepared and the foundations built. Three chief systems are in vogue for works of this kind—the "coffer-dam," the "open crib," and the "pneumatic caisson."

Coffer-dams.—The coffer-dam is a temporary water-tight wall or dam built around the site to be excavated, enabling the latter to be pumped dry and kept dry while the foundations are building. The walls of the dam are composed of two parallel walls or rows of sheet piling, with the intervening space filled with a "puddling" of clay or clay and sand (Figs. 13 and 14). In constructing a coffer-dam a row of ordinary piles is first driven just outside of the proposed exterior line of sheet piles, and their heads bolted or framed to heavy stringers, and sometimes also to subordinate stringpieces, *i i*. They are thoroughly braced by cross-pieces, *e*, to resist the water-pressure after the dammed area is pumped out. The outer row of sheet piles is then driven firmly into the bottom soil and spiked to the stringpieces framing the pile-heads. A second row of piles is then driven inside the proposed inner row of sheet piling; or strong posts, *b*, are set in their place, framed to string-pieces secured by the cross-pieces *e*, and to wales *n n*, against which are driven the interior series of sheet piles. The intervening space, A, is then filled with the puddling material, rammed as thoroughly as may be in the water, and the water in the interior inclosed space, B, is then pumped out. As its level descends strong struts, *o o*, are fitted across from wall to wall of the dam to prevent its bulging inward from the external water-pressure. As the masonry rises they are removed, and short struts inserted between the masonry and the dam in their places. There is always considerable leakage, especially where the area is excavated to a considerable depth below

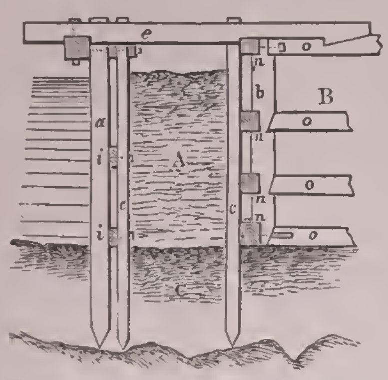


FIG. 13.—Section of coffer-dam: *a*, main exterior piles; *b*, strong square beams, corresponding to *a*, on which the wales *n n* are notched and bolted; *c*, sheeting-piles; *e*, cross-pieces; *o o*, horizontal shores buttressing opposite sides of dam; A, puddling; B, interior space; C, mud, etc.

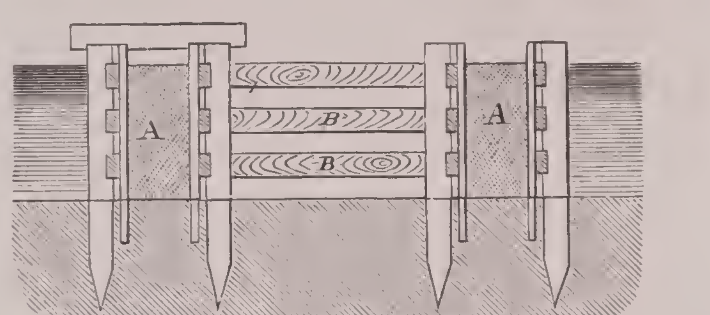


FIG. 14.—Coffer-dam, showing detail.

the natural bottom; and the pumps must be kept in constant operation, with renewal of the puddling when this is little by little washed out into the inclosure by the leakage. It is economical to make the interior area from 6 to 10 feet wider each way than the proposed structure, as this allows sufficient room for the workmen and for repairs on the dam.

The Open Crib, or Caisson.—Coffer-dams are practicable only in water of moderate depth, and on sites requiring but little excavation to prepare the bed. Where these conditions do not exist, and especially in the case of bridge-piers in rivers of considerable depth, the "open crib" or "open caisson" is frequently employed. This is an open box-like structure of timber or iron, provided with a partial flooring or shelf, upon which is loaded a sufficient weight to sink it when it has been floated to the proper position, the height of the crib being sufficient to reach above the water when so sunk. The bottom of the area it incloses is then dredged out, and the crib sinks gradually down into the excavation, successive sections being added to its height as it descends so as to reach constantly above water. In this way a species of coffer-dam may be finally established from which the water may be pumped, and the bed prepared for the foundations in the usual manner. More often, however, the excavation having been carried down to rock or to a firm bearing, the crib is filled with concrete, and the piers built up on this material without pumping out the water. Iron cribs have been frequently employed for structures of this kind, remaining as a permanent part of the foundation up to the water-line, from which level the pier or other construction is carried up in masonry. The crib is usually built on shore and launched and floated into position, though sometimes begun on shore and completed after launching: it has double walls, and if of large size the open area is divided into compartments by double-walled longitudinal or transverse partitions. These double walls are made to converge to a cutting edge at the bottom, and this converging portion is built up solid if the crib be of timber. Usually the lower part of the crib is given a certain spread or "batter"; the utility of this has been questioned by some engineers. The Poughkeepsie bridge over the Hudson river, New York, rests on four piers founded on cribs of hemlock, with white-oak cutting edges; they measure 60 by 100 feet, and are 104 feet high. The double walls, of 12 by 12 inch hemlock, are about 10 feet thick; the total depth reached is about 135 feet below low-water level, the crib finally resting on a layer of hard gravel after passing through silt, clay, and sand. Another remarkable example of crib foundations is the railroad bridge at Hawkesbury, New South Wales, in which the cribs are of iron, 52 by 24 feet at the bottom, 48 by 20 feet at the top, and were sunk to various depths up to 118 feet below the river-bed. Each crib was divided into three compartments, in each of which was an iron well 8 feet in diameter with a flaring bottom. The cribs were sunk by filling with concrete the open spaces or corners around these wells, which were also filled with concrete after the sinking of the crib, and served as foundations for masonry piers built up to 42 feet above low-water. For the Victoria tubular bridge at Montreal open caissons, shaped as in Fig. 15, were employed; when

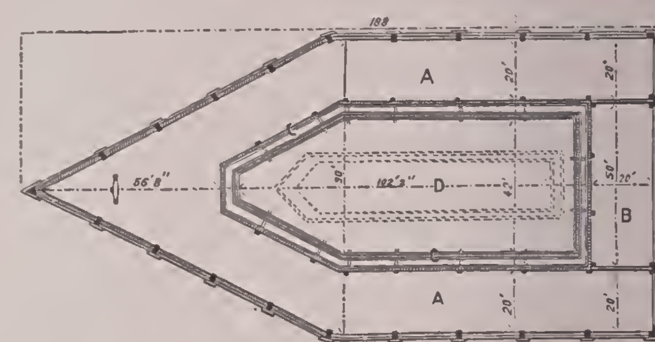


FIG. 15.

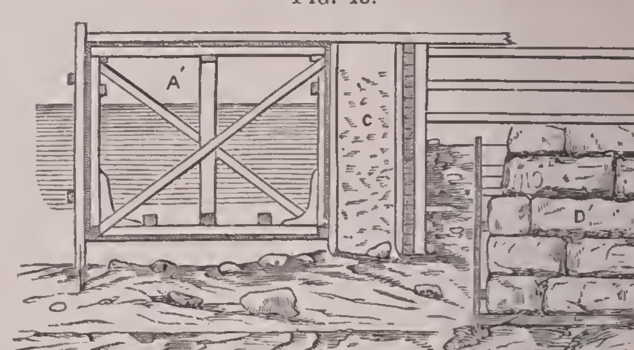


FIG. 16.

FIGS. 15 and 16.—Open crib, Victoria bridge.
A, caisson; A′, cross-section of caisson; *c*, cross-section of puddling; D′, foundation courses of piers.

brought into position and sunk they were anchored to the bottom by iron pins in the corner posts; the space C (Fig. 16) was filled with puddling, forming a coffer-dam; the space D was then pumped out and the pier built up within it. Fig. 17 shows a variety of open crib sometimes used in small work in shallow water where the natural bottom is firm and level; it is merely an open box sunk into position by the weight of the masonry built up within it. This is primitive and elementary; a more scientific form is that in which such a box-crib is combined with a pneumatic caisson, as will be later described.

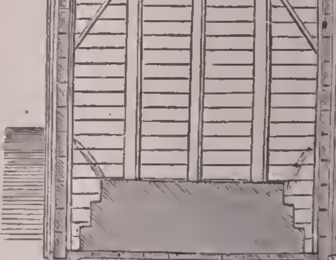


FIG. 17.—Open crib.

The Pneumatic Caisson.—This is the device most commonly employed for sinking foundations in water, sand, etc., to depths varying from 30 to 100 feet. It is used in many forms, in all of which the principle of the diving-bell is made use of to expel the water from beneath a species of crib or caisson, and thus permit of excavation by hand. An air-tight caisson or inverted box, constructed with strong walls, usually double, and having a cutting edge at the bottom, is floated over the destined site, and sunk either by loading with stone and gravel or concrete, or by the weight of the masonry built up upon it, its walls being constantly added to, as in the open crib, so as to extend above water and allow the mason-work to be executed at any level. The caisson forms a diving-bell, and serves as a working-chamber, in which the labor of excavating beneath the cutting edges may be carried on by hand. A constantly increasing pressure of air is supplied by "compressors," or air-pumps, as the structure sinks into the excavated bottom; this effectually excludes the water at all times. In case of any defect or error making the raising of the caisson desirable, this may be effected by an increase in the pressure under the chamber; and, on the other hand, the sinking may be accelerated by reducing the pressure, or withdrawing it altogether. Uneven sinkage may be in part controlled by allowing the air to escape under the edge or through openings in the side where the sinking is too slow; the escaping air scours out the sand whose friction impedes the descent of that side of the caisson, and thus releases it. Bowlders are removed by a jet of water under them, or, if of great size, by blasting. Workmen and material are admitted to and withdrawn from the working-chamber by means of "air-locks." When a final level and solid bearing is reached, the interior of the working-chamber is filled with concrete, and forms a solid and permanent base for the masonry already completed above the water-level. It is obvious that the pressure of air in the working-chamber must increase with the depth of sinkage, in order to exclude the water; a depth of 100 feet below the water-level would require a pressure of three atmospheres, or 45 lb. per square inch in addition to the normal atmospheric pressure of 15 lb. Many difficulties result from this pressure. It offers a strong resistance to sinkage, which must be overcome by extra loading. It requires the greatest care in constructing and operating the caisson, which must be substantially air-tight and provided with abundance of air-compressors to guard against accident. The heavy pressure in the chamber is not only painful, but often injurious to the health of the workmen, whose "shifts" must be reduced in length as the pressure increases. This pressure also raises the temperature of the air in the chamber, and retards the setting of concrete used within it, unless compounded with dry porous brick instead of stone, or ventilated by sections of gas-pipe admitting the air into the body of the concrete as it is being laid. Difficulty is often encountered in securing a perfectly vertical settlement of the structure; in some cases it has been necessary to correct final errors in the settlement by deviating the superstructure from a true verticality for a greater or less distance.

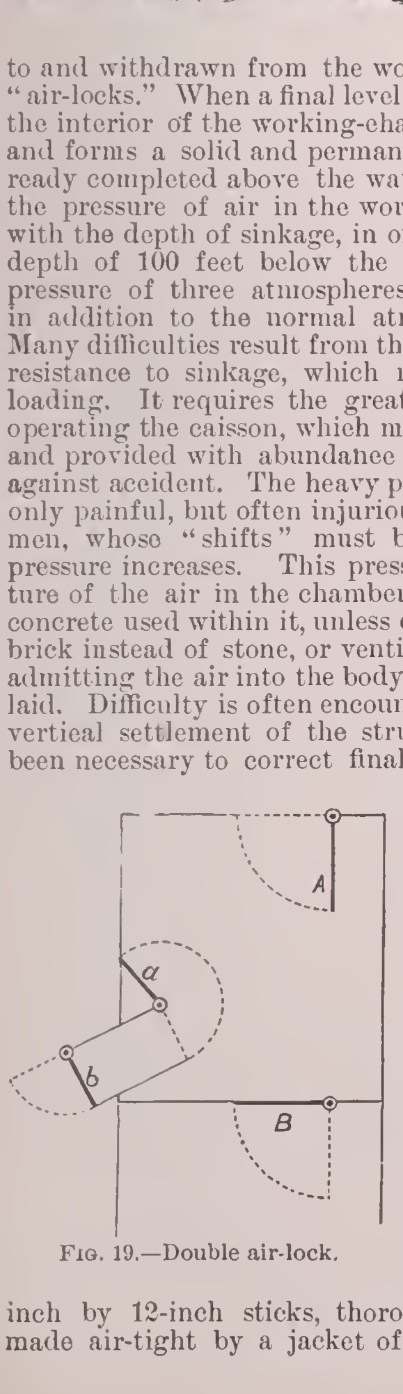


Fig. 19.—Double air-lock.

Fig. 18 shows a section of the caisson foundation for one of the two piers of the New York and Brooklyn (East river) bridge, designed by J. A. Roebling, and completed by J. A. Roebling, Jr. (See article Brooklyn.) The caissons are 168 by 102 feet, and 172 by 102 feet in size, and about 26 feet high, constructed of timber with battered sides and cutting edges, 9 feet thick at the top and 10 feet high. The material is yellow pine in 12-inch by 12-inch sticks, thoroughly bolted together, and made air-tight by a jacket of tin between the third and fourth courses, or layers of timber in the solid ceiling, and extending down the sides. Each caisson had two wells of boiler iron extending below the bottom of the caisson, the water remaining in them at the normal level. Dredges were operated through these wells to remove the excavated material from pits into which it was thrown by the workmen. Each pier consists of two arches, carried by three piers of masonry; in the openings between these were two open cribs extending above the water-level, and containing the air-locks and supply-shafts. The New York caisson was sunk to firm bottom 78 feet below the water-level; the Brooklyn caisson to a depth of 50 feet.

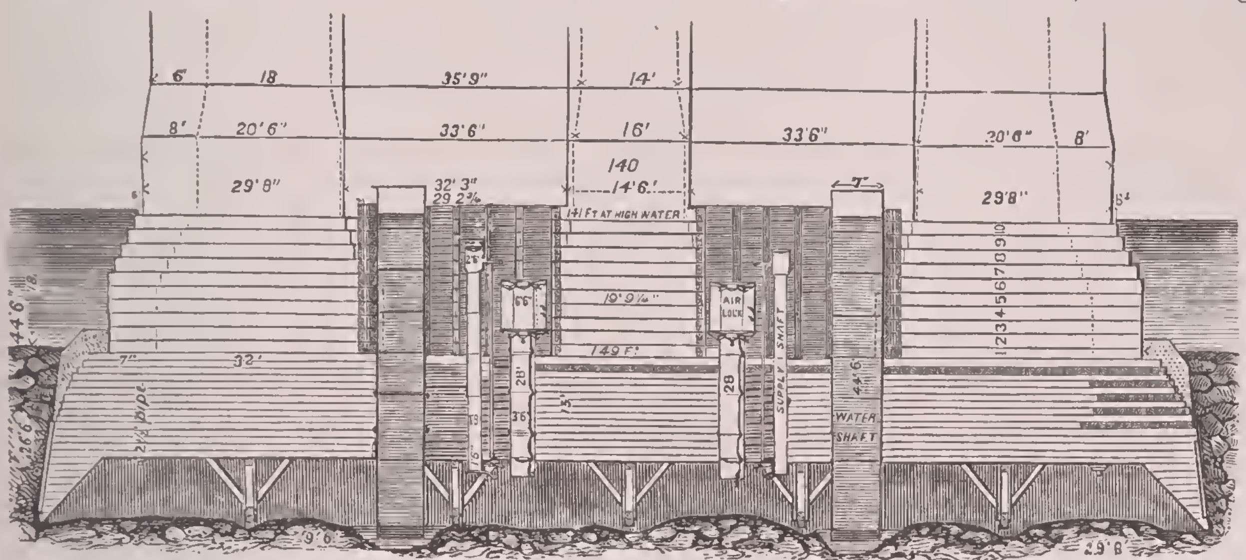


Fig. 18.—Caisson, Brooklyn bridge.

The "air-lock," by which access is had to the working-chamber, is a small air-tight chamber, usually of boiler iron and circular in form, surmounting a shaft leading to the working-chamber. A valve or door admits to its upper end, and another, in the bottom, to the shaft; both are hinged to open downward. The workmen having entered by the upper door, this is closed, and the lower door opened, admitting the compressed air until the pressure in the lock and chamber is equal, when the workmen descend into the chamber. In quitting the caisson the process is reversed, and the operation is the same in introducing supplies or extracting material as in admitting or withdrawing the men. A lockful of compressed air is of course wasted at each "locking"; to reduce this loss in the discharge of material a smaller sup-

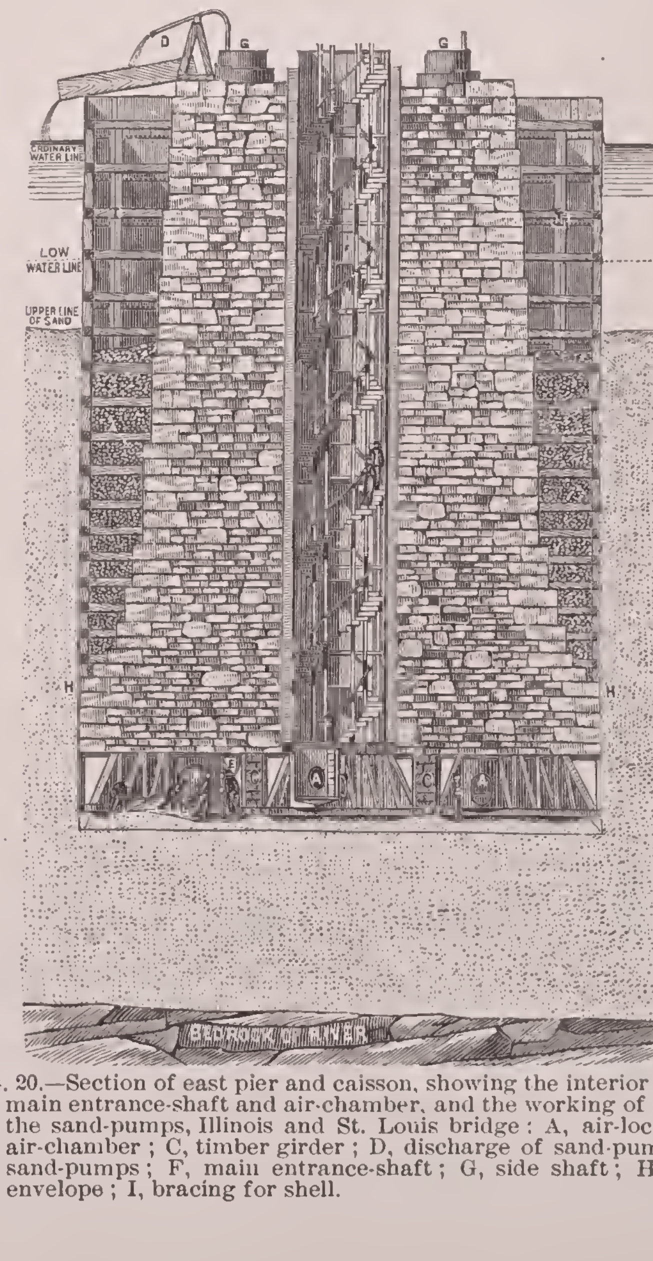


Fig. 20.—Section of east pier and caisson, showing the interior of the main entrance-shaft and air-chamber, and the working of one of the sand-pumps, Illinois and St. Louis bridge: A, air-locks; B, air-chamber; C, timber girder; D, discharge of sand-pump; E, sand-pumps; F, main entrance-shaft; G, side shaft; H, iron envelope; I, bracing for shell.

plementary lock is sometimes connected with the main lock. It is shown in Fig. 19. The rubbish is placed in the inclined spout-like supplementary lock through the door *a*, which is then closed, and *b* opened, allowing the rubbish to slide out into the water.

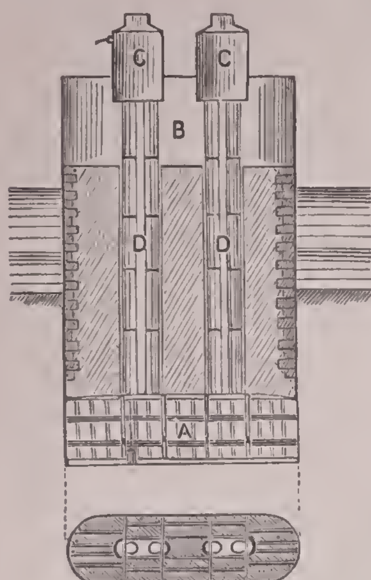


Fig. 21.—Pneumatic pier.

There are many variations of detail in the pneumatic caissons employed in bridge and lighthouse building, most of which combine the essential features of the crib and caisson. The walls of the caisson continued upward, form an open crib above the working chamber; this excludes the water, permits the masonry to be built irrespective of the rate of sinkage, and allows the air-lock to be placed close to the roof of the caisson. Fig. 20 illustrates the caisson and crib of the east pier of the St. Louis bridge, designed by James B. Eads. It shows the air-locks at *A*, and the open well in the center. This foundation is sunk to a depth of 110 feet below the water-level, through clear sand, which was excavated by sand-pumps, operating by the pressure of the compressed air, and discharging, as shown, at D. In this case the crib walls were removed above low-water level when the pier was completed. In many cases the crib is a permanent circular structure of boiler iron, which is lined or filled solid with masonry, or, when of small diameter (as 8 feet or under) with concrete. The air-locks are often in such cases placed at the top of the tube or crib, and removed alternately from one crib to the other as the cribs are extended upward. Such tubes are sometimes called pneumatic piles, and are illustrated by Figs. 21 and 22. The latter represents the piers of the first Tay bridge across the Firth of Tay, Scotland. Each pier was composed of two iron columns or cylinders of iron $9\frac{1}{2}$ feet in diameter, built up in sections about 4 feet high, rising above a single working-chamber, $22\frac{1}{2}$ feet long, $10\frac{1}{2}$ feet wide, and about 8 feet high. The whole of both columns opened into this chamber, forming together a single caisson. Each was surmounted by an air-lock, and the whole pier was sunk by lining the cylinders with masonry $2\frac{1}{2}$ feet thick, supported on a sort of shelf on the interior near the base, and leaving a well in the center of each and opening up to the air-lock. Fig. 23 is a transverse section of the shore-pier at the French end of the Kehl bridge over the Rhine, showing the dredging well in the center and the two compressed air-shafts leading to the air-locks at the top. These air-shafts were used alternately, one being lengthened while the other was in use. The caissons were quadruple, giving four wells and eight air-shafts for each pier, the masonry being built around the shafts as fast as they were sunk. This bridge dates from 1859. Fig. 24 is a section of one of the cylindrical pneumatic piles or caissons of the Szegedin bridge over the Theiss, Hungary. Each pier consists of two columns or piles, which were filled with concrete when the final bearing was reached.

These examples sufficiently illustrate the general form and applications of the pneumatic caisson to bridge-building. It was for the first time applied to the foundations of an office-building, that of the Manhattan Life Insurance Company in New York city. Fifteen caissons were used, of boiler steel, eleven of these being rectangular in plan and four circular, the sizes varying from 15 by 25 feet to 26 by 26 feet for the former, and from 10 to 16 feet diameter for the latter. The fifteen caissons were put into position at the same time and sunk to bed-rock, 50 feet below the street-grade and 25 feet below the proposed cellar-floor. Upon them were built footings of hard brick in cement, capped with several courses of granite, on which rest the bed-plates of the metallic columns of the building, some of which sustain a load of 1,500 tons.

Many details of the science of pneumatic foundations have been necessarily omitted, as these will be more properly looked for in the standard works on engineering and bridge-building. So also must be passed by, with only brief mention, some of the more special and unusual processes for sinking shafts for foundations in quicksand. One of these is the Poetsch freezing process, which freezes the quicksand so that it can be cut, dug, or excavated like any solid. Pipes 6 or 8 inches in diameter are driven down to the necessary depth in a circle around the proposed excavation, and brine, cooled by an ammonia freezing-machine, is circulated through them, freezing the quicksand gradually for several feet in every direction. Another very ingenious process employed with success is that invented by Robert L. Harris, of the American Society of Civil Engineers. Pipes are driven at short distances apart to the required depth, and a current of water forced through the alternate pipes, scouring a passage out from each to the nearest adjacent pipe, through which it escapes, carrying the sand with it. In this way channels are cut from pipe to pipe, and eventually a species of chamber is formed, after which liquid cement is introduced through the pipes into the channels or chambers, in which it mingles with the sand and solidifies, forming ultimately a wall or a floor of concrete, according to the way the pipes are distributed and manipulated. By this process a sewer-channel 4,000 feet long and 16 wide has been excavated 25 feet deep through very fluid quicksand, and great claims are made for its practicability in all similar cases.

It is beyond the scope of an article like this to enter further into the practical and scientific details of foundation-building; for these the reader should consult the professional text-books on engineering. A few historical observations are proper in conclusion.

The Egyptians appear to have taken small pains with their foundations. The compact soil, the dry climate, and the

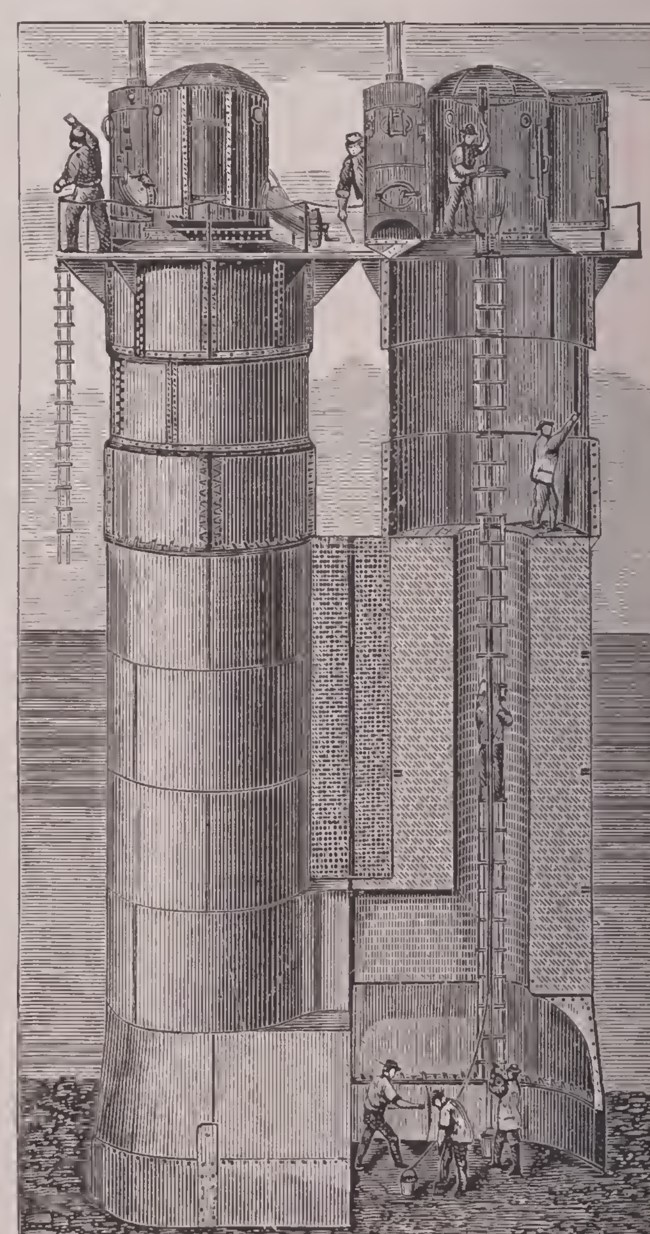


Fig. 22.—Tay bridge pier: Sinking the caissons.

absence of frost made deep excavations unnecessary. The massive, but ordinarily not very lofty, masonry of their temple-walls rests in most cases on a species of platform or wide footing composed usually of stone, but sometimes of sun-dried bricks, and laid in trenches excavated but 5 or 6 feet. Maspero testifies that in all cases under his observation these crude foundations had not failed, but other writers ascribe the ruin of the great temples largely to the failure

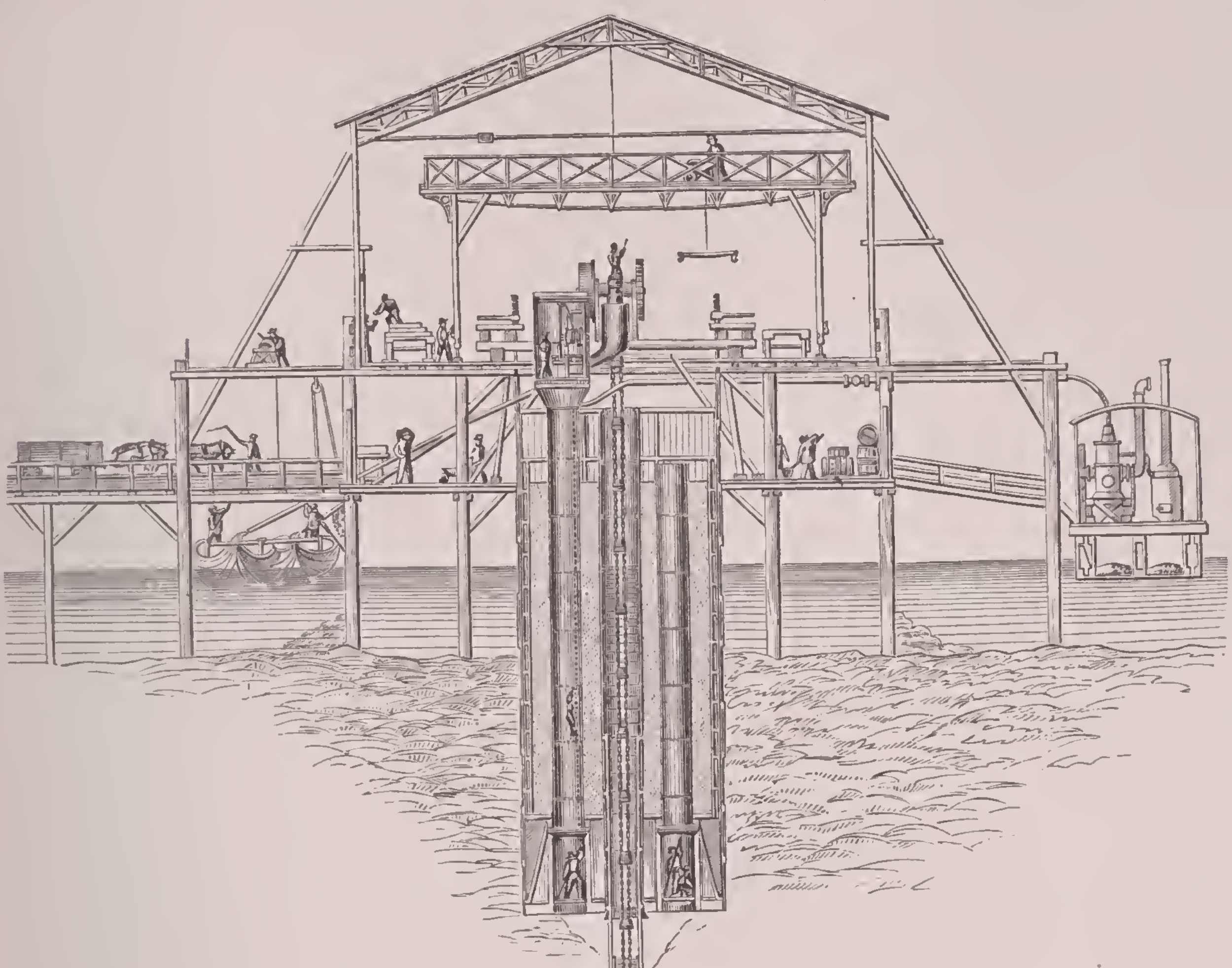


Fig. 23.—Cross-section: shore pier of Kehl bridge (French side).

of their foundations, due in many cases to the infiltration of the Nile overflow. The Greeks took greater pains with their foundations, excavating to a considerable depth and in some cases covering the area thus laid bare with a layer of charcoal or ashes several inches thick, upon which were built the footing courses of hard stone, carefully cut and laid dry. The excellence of the mason-work of the superstructure, laid up without mortar and doweled, with close joints and deep bearings, doubtless contributed to the stability of the foundations by the absence of unequal settlings throwing unequal strains upon them. The Romans appear to have been the pioneers in the scientific engineering of foundations, for which they excavated in most cases to the rock, spreading the footings to a wide bearing and laying them up in cut masonry carefully fitted and cemented. They made free use of concrete and hydraulic cement made with *pozzuolana* or hydraulic lime and pounded brick, and the foundations of isolated piers were frequently consolidated by means of inverted arches. They also made use of piles and employed coffer-dams in subaqueous constructions, in which they displayed great skill. According to Choisy (*L'art de bâtir chez les Byzantins*) the principle of isolated or independent foundations in an elementary form was applied in preparing the substructure of the Church of the Divine Wisdom, 532 A. D. These foundations cost over $1,000,000, but having for 1,300 years carried the massively vaulted edifice without failure, in spite of severe shocks of earthquake, they have demonstrated the wisdom of this heavy expenditure. Among foundations of mediæval buildings those of the leaning tower and cathedral at Pisa have perhaps excited the most controversy and discussion, one side claiming that the inclination of the tower and of certain lines of masonry in the cathedral walls was purely accidental, and due to sinkage of the foundations, the other that these deviations were a part of the design. It is generally admitted, however, that the piles under one side of the tower sank under the imposed load, either gradually or, more probably, quite suddenly, when several stages of the tower were finished, perhaps by breaking through a more solid into a softer stratum, and that the diminished inclination of the upper stages was an effort to correct in part the consequent leaning without too abrupt a break in the lines. With regard to the cathedral there is more apparent evidence for intentional irregularity, though it is far from conclusive. Most of the mediæval buildings, both ecclesiastical and secular, were vaulted structures, and consequently very heavy, requiring extremely well-built foundations. The majority of those whose foundations have been examined are built on widely spreading footing courses, "drawing in" to the base courses of the walls somewhat gradually, and laid up in regular courses of carefully fitted masonry from a bed on solid rock or compact gravel in most cases. The presence or absence of a firm substratum would in many cases determine the adoption or abandonment of a given site for a cathedral or church. Many spires, vaults, and walls undoubtedly fell during the Middle Ages, of which mishaps the record is lost or forgotten, some collapsing from inherent vices of construction, some from insufficient foundations. The walls and piers of Peterborough Cathedral, England, have long been seamed and cracked by the failure of the foundations, and Salisbury Cathedral was saved from the ruin which menaced it, owing to the sinking of its foundations in the moist soil, only by their being encased and in some cases underpinned with concrete, thereby increasing their area and excluding the moisture from the mortar in their joints. Modern engineers have revolutionized the building of foundations by the application of the open-crib and pneumatic caisson; the development of the manufacture and use of concrete and hydraulic cement; the invention of the screw pile and sand-pump; and the reduction to definite statistics and formulas of an ever-increasing experience in the building of bridges—especially for railroads — and lofty structures in cities. For further particulars, the reader is referred to the files of the various engineering journals, to standard works of reference and text-

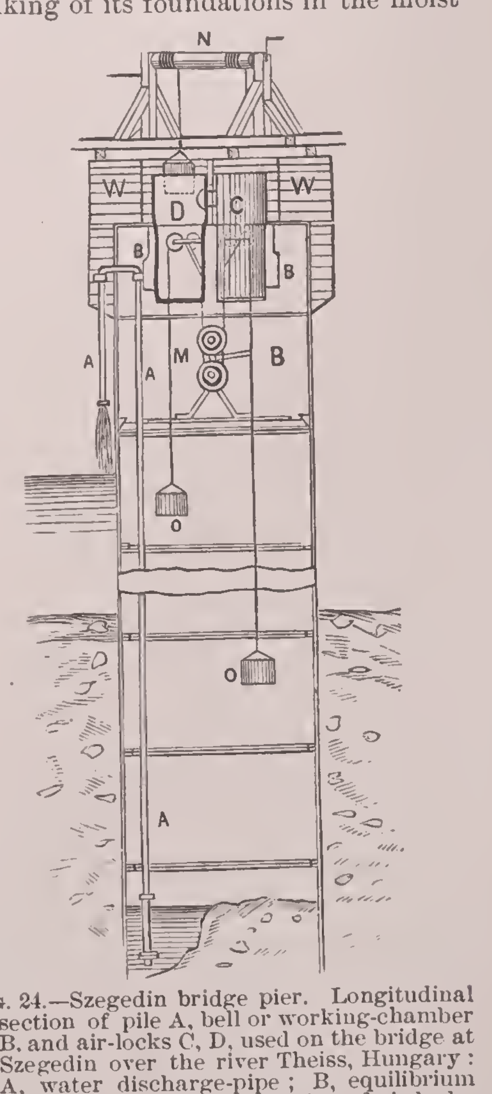


Fig. 24.—Szegedin bridge pier. Longitudinal section of pile A, bell or working-chamber B, and air-locks C, D, used on the bridge at Szegedin over the river Theiss, Hungary: A, water discharge-pipe; B, equilibrium tubes of air-lock; C, elevation of air-lock; D, longitudinal section of air-lock; M, hoisting-gear in the bell; N, hoisting-gear for air-lock; W, counterpoise to compressed air.

books, such as the engineering and architectural handbooks of Trautwine, Haswell, and Kidder; Rankine's *Civil Engineering*; Patton's *Practical Treatise on Foundations*, and Baker's *Masonry*; also to the articles BRIDGES and LIGHTHOUSE in this work. A. D. F. HAMLIN.

Founder [deriv. of *founder*, go lame < M. Eng. *foundren*, from O. Fr. *fondrer* in *effondrer*, fall in, sink, founder, deriv. of *fonder*, fall, deriv. of *fond*, bottom < Lat. *fundus*, bottom]: an inflammation primarily attacking the laminæ of the horse's foot (*Laminitis*). This disease may follow overdriving, exposure to cold when perspiring, overfeeding, or giving food or drink too soon after hard work; long-continued driving on pavements or on frozen ground and bad shoeing are fruitful causes. The fore feet are usually affected alone, but the fore legs and chest-muscles sometimes share in the disease, and these muscles undergo a sort of atrophy (chest-founder) in consequence of its long continuance. The disease resembles rheumatism in many respects. Like that, its acute form is attended by great fever and pain. Bleeding is admissible in a young strong horse suddenly foundered. The shoes should be taken off, the hoof covered with a hot poultice, the stall littered heavily, and in severe cases the horse slung up from the floor. After the acute stage is over the horse should be put to pasture if possible, and allowed to run as long as he can be spared, except in severe weather, when he should be housed. A foundered horse can be detected by his mincing gait, by his resting his fore foot upon the toe, by a hot or contracted hoof, and by delicate signs recognized with difficulty by any except practiced observers. For an established founder there is no possible cure. See FARRIERY.

Foundling Hospitals: institutions for the reception and support of infants and children that have been abandoned by their parents or guardians. Such institutions are maintained by government appropriations or by private or sectarian associations. Children found abandoned are known as foundlings, and the cause of their desertion is in most cases illegitimate birth, though not a few are born in wedlock and are abandoned by parents unable to provide for them. The necessity of providing for such children, and restraining infanticide, led to the establishment of foundling institutions by most civilized nations.

As early as the sixth century a species of foundling hospital existed at Treves, where a marble basin was located in front of the cathedral, in which parents could deposit children they wished to abandon, the care of such foundlings being given by the bishop to members of the church. In Rome also, in the sixth century, public institutions existed for the reception of foundlings, called by Justinian *brephotrophia*, and in the seventh century similar ones existed at Anjou in France. One was established at Milan in 787 by an arch-priest named Datheus, for the object of preventing infanticide. In 1070 a foundling hospital was established at Montpellier, and a second one in 1180, known as the Hospital of the Holy Ghost. In 1200 one was established at Eisenbeck, and in 1212 one in Rome. In Florence a magnificent one, the Spedale degli Innocenti, was established in 1317. Similar institutions were founded in Nuremberg in 1331, in Paris in 1362, and in Vienna in 1380. The Hôtel Dieu of Lyons, founded in 1523, was one of the first in France where foundlings were not only received, but were educated, and in 1536 a similar one was established by Francis I. In Paris in 1563 a foundling hospital was established by the Church, and managed by an association of priests. In this children received a careful education, many of the boys being trained for the priesthood. Recognizing the necessity of providing for abandoned infants, St. Vincent de Paul collected funds sufficient to establish a new foundling hospital in 1640. In 1670 this hospital was converted into a public one by Louis XIV., and subsequently it was enlarged. After 1789 the French republic assumed the charge of foundlings, and in 1793 the terrorists declared them all to be *enfants de la patrie*. An imperial degree in 1811 continued the arrangement by which foundling hospitals had become Government institutions and the foundlings children of the state. It further ordered the establishment of such hospitals in each arrondissement of France, the children to be kept in them until six years of age, when they were to be intrusted to respectable persons, who received a stipend for their support and education. This stipend is yearly reduced until the children attain the age of twelve, when the able-bodied boys are placed at the disposal of the Minister of the Marine, while delicate ones are provided with suitable work. Prior to 1811 the reception of foundlings was public, but by the decree of that year each hospital was provided with a turning-box in which the child could secretly be deposited. In most of the Roman Catholic countries of Europe the same system as that in force in France was adopted, and in many of them it still prevails. In Belgium and France the turning-boxes have been abolished since 1834, and the secret reception of foundlings has been declared illegal in the latter country. Since 1886 children are admitted to the foundling hospital at Paris under a system which amounts to indiscriminate admission, it being possible to leave an infant without giving any particulars relating to it. The same institution admits incorrigible children, who are called *moralement abandonnés*, in distinction from *enfant assistés*, as those of all other classes are designated. In 1784 a large foundling hospital was established in Vienna by Joseph II. In 1762 a foundling hospital was founded in Moscow by Catharine II., being afterward greatly enlarged, so as to include a lying-in department and schools. The Vospitatelnoi Dom in St. Petersburg was founded in 1772, also by Catharine II., as a branch of the one in Moscow, and like it has since been greatly enlarged, and has a lying-in department and a school. According to the laws of Russia, all foundlings are the property of the Government, and the army and navy are largely recruited from this class. Owing to the prevalence of the crime of infanticide in China, a foundling hospital was established about 1856 in Canton. In the city of Mexico there has long been a *cuna* or foundling hospital maintained by private means, and receiving the supervision of certain ladies. The infants are kept in the institution one month, and are then sent to the country or villages in charge of a nurse, who is responsible to somebody in the neighborhood. These children after a certain age are generally adopted by respectable persons. In the foundling hospital in Rio de Janeiro all the male children are apprenticed at maturity to trades, and the girls are educated to make able and useful wives. The great hospital of Santo Spirito in Rome has a foundling department capable of holding 3,000 children, and farms out the most of its infants. At Naples the foundlings receive more attention than in any other Italian city. The Dei Trovatelliale Annunziata, which was founded in the thirteenth century, has a costly educational establishment also. Every foundling received has a number fastened around its neck to aid in future recognition. Two infants are given in charge of one out-door wet-nurse, and on attaining the age of eighteen months are intrusted to the nuns for further care. Every infant received in the foundling hospital of Florence is farmed out, the wet-nurses receiving ten francs a month, and a further gratuity if they retain the foundlings until their eighteenth year. The girls on being married receive 235 francs. In the Madrid hospitals the infants are also farmed out until seven years of age, when they are transferred to the college of the "Forsaken" (*Desamparados*) to be educated. In Portugal the Santa Casa de Misericordia in Lisbon contains an immense foundling department, conducted in a manner similar to those in Spain. The foundling hospitals in Vienna and Lower Austria receive infants on the following conditions: Declaration of the community to which the infant or mother belongs, of her religion, and proof of its illegitimacy in case it is to be received permanently. Admission is free to infants born in hospitals. Admission is granted to illegitimate children on payment of a stipend by the relatives or townships of the mothers. The institutions provide for the children until their tenth year, after which their support must be assumed by their native village or town. In the Prague foundling hospital the children are only kept a short time, and are then farmed out in the country, only those being kept in the institution who are feeble, and for whom nurses can not be found outside. Those given in charge to outside parties are claimed by the institution, and at their sixth year receive a free schooling. At the age of ten years the institution relinquishes all claim to the child, when the village or town of the mother must provide for its support, or its own mother may reclaim it on proving her ability to provide for it. In Munich the following rules for the care of illegitimate children are strictly enforced: It is a misdemeanor to take charge of such children under eight years of age without approval of the police authorities, and such permission is refused unless the character, circumstances, and locality of the petitioner are satisfactory. The infants given in charge of nurses are first examined by medical men, and no women are allowed to receive foundlings to the neglect of their own children. The management of the London Foundling Hospital, which was founded in 1739 by Capt. Thomas Coram and is not strictly speaking a foundling hospital at all, is as follows: The governors meet once a week to receive petitions for the admission of children. A child can be received only upon personal application of the mother, who is obliged to state the circumstances requiring her to abandon her child, and to give her name, residence, age, date of child's birth, sex, father's name and occupation. Shortly after admission the infants are sent into the country, where they remain until their fifth year, when they are returned to the institution, where they are educated. At the age of fourteen the girls are apprenticed out as domestic servants until the age of twenty. The boys at the age of sixteen are apprenticed as mechanics until they attain the age of twenty-one years. In both cases those to whom they are apprenticed are held to a strict accountability for their physical and moral wellbeing. After the termination of the period of apprenticeship, the institution ceases to exercise any control over the foundlings. In Great Britain the boarding-out system for foundlings has met with great approval, but in the U. S. it has been the occasion of much cruelty, leading to criminal prosecutions. The advantages claimed for this method are that the children are removed from pauperizing tendencies, and are put upon an equal footing with other children. It is claimed that foundlings thus brought up have in most instances become good men and women. In Scotland the boarding-out system has been widely adopted, and from its marked success has won universal approval. In the U. S. the care of foundlings in institutions is the universal system, and most of the larger cities have their foundling hospitals, either under control of and supported by private and sectarian associations, or the State and municipal government. The turning-boxes or cribs have been abolished almost wholly. In 1893 the general Government, through the census office, made the first attempt to gather statistics relating to foundling hospitals throughout the U. S. Revised by F. STURGES ALLEN.

Foundry [also *foundery*, from Fr. *fonderie*, deriv. of *fondre*, pour, found, cast < Lat. *fun'dere*, melt, pour]: an establishment for shaping metallic figures by pouring the molten material into molds in which it cools and is solidified. The operation is called casting or founding. Metal casting was successfully practiced in ancient Assyria, Babylonia, Phœnicia, and Greece, and the Chinese and Japanese have long excelled in casting both iron and bronze. In modern times in more highly civilized lands casting has attained great perfection. Iron-founding, brass, bronze, and type founding are special forms of the art. Of especial importance is the formation of the mold, within which, if the casting be hollow, a *core* is placed. The mold is in general formed of loam, molding-sand, plaster, or even, for some articles, of metal. For small and nice objects pounce, or powdered cuttle-bone, is sometimes used for making the mold. The core is always of some material which will yield during the contraction of the metal. Type-foundries employ steel molds. (See PRINTING.) In the iron-foundry the metal is generally melted in a furnace of the form called *cupola*; coke, charcoal, and in the U. S. anthracite, are employed in melting the iron. For many forms of nice casting, requiring clean edges and well-defined lines, bog iron, which is often heavily charged with phosphorus, is preferred, since it is more perfectly liquid when in a molten condition than most other kinds of iron. The variety of articles now manufactured in a foundry is very great. The principle employed in all kinds of casting is very obvious and simple, but the practical details are very numerous, and can be properly learned only by experience. See METALLURGY and MOULDING.

Fountain [M. Eng. *fountayne*, from O. Fr. *funtaine*, *fontaine* < Low Lat. *fontana*, deriv. of Lat. *fons*, *fontis*, spring, fount]: an outbursting stream or jet of water, especially one artificially produced, either for use or decoration; though the name is still applied to historic natural springs, as of Egeria, Bandusia, or Vaucluse. Decorative fountains, probably first used by the Romans, were designed in great numbers by Italian architects of the Renaissance, and have ever since been important features in the adornment of parks and squares. In some the architectural or sculptural treatment of the basins is most prominent, in others the arrangement of the jets and masses of water. The Fountain of Trevi and the Acqua Paola at Rome, the Cascade at Caserta, the Grandes Eaux at Versailles, the fountains S. Michel and des Innocents at Paris, and the Triumph of the Republic at Chicago (1893) are conspicuous examples of such works. *Drinking-fountains* are provided for public use in modern cities by public enterprise or private munificence; in Oriental lands their erection is deemed an act especially to be rewarded in paradise. A. D. F. HAMLIN.

Fountain of Youth: a mythical spring which, according to Indian stories of the sixteenth century, existed in a country sometimes called Bimini; the waters, it was said, had the power of healing the sick, restoring the aged to youth, and conferring immortality. The story was current in the West Indies and parts of Central America, and Bimini was described as a beautiful island or region toward the north. The Spaniards at first supposed it to be one of the Bahamas, and later Florida, a region near the Mississippi, or even Mexico. Ponce de Leon sought for the fountain in Florida, 1512 and 1521, and it was one of the incentives which led to the later expeditions of Narvaez and Soto. Similar myths have been recorded in the Old World. H. H. SMITH.

Fouqué, foo'kā', FRIEDRICH HEINRICH KARL, Baron de la Motte: poet and novelist; b. at Brandenburg, Germany, Feb. 12, 1777. His family was French, but had emigrated to Prussia after the Revocation of the Edict of Nantes. His father was a major-general in the Prussian army, and he himself served in the campaigns of 1792 and 1813, but retired from the army, on account of ill-health, with the rank of major, and resided at Paris, at Halle, and on his estate of Nennhausen. He was a very prolific writer. In 1801 he published, under the pen-name *Pellegrin*, *Dramatische Werke*. *Sigurd* followed in 1808; *Undine* was written in 1811; *Corona*, poem, in 1814; *Der Zauberring* (The Magic Ring) in 1816; *Eginhard und Emma*, drama, and *Bertrand du Guesclin*, epic poem, in 1821; a collection of his poems, containing most of his lyrics and all his dramas, appeared in five volumes 1816–27. A posthumous romance, *Abfall und Basse*, was published in 1844, some *Geistliche Gedichte* in 1858, and *Christlicher Liederschatz* in 1862. He belonged to the Romantic school, and was at one time extremely popular in Germany. D. in Berlin, Jan. 23, 1843.

Fouqué, HENRI AUGUSTE, Baron de la Motte: Prussian general; b. at The Hague, 1698; served in the Prussian army against Charles XII. of Sweden 1715; acquired the friendship of the Prussian prince-royal, afterward Frederick the Great, and received a command from him in 1740; rose to the rank of a general (1759) in the wars of Frederick; was wounded and taken prisoner at the battle of Landschut in 1760; and died at Brandenburg, May 3, 1774. His memoirs were published in German (1788).

Fouquet, or **Foucquet**, NICOLAS, Viscount of Melun and Vaux, Marquis of Belle Isle: minister to Louis XIV.; b. in Paris, 1615; educated for the civil service; rose rapidly in the favor of the court, and at the age of thirty-five was made procureur-general to the Parliament of Paris. Enjoying the favor of Cardinal Mazarin and of Anne of Austria, the queen-mother, he was three years later appointed superintendent of the finances. The treasury was then in a bad condition, owing to mismanagement, official extravagance, and the greed of courtiers, and Fouquet is said to have advanced money from his private estate and made loans on his own credit to supplement the revenues. But as he grew in power he became indiscreet, made an enemy of Mazarin, who thenceforth determined on his destruction, offended the king by his lavish display, and above all angered him by his advances to the royal mistress, La Vallière. When, on the death of Mazarin, Louis determined to be his own Prime Minister, Fouquet, wishing to retain his influence, exaggerated the financial distress of the Government; but the king, carrying the report to Colbert, who coveted the ministry of Finance, was made aware of the falsity of the figures. Nothing was done, however, to show Fouquet that he was in disfavor, for it was the king's wish that the arrest should be postponed till Fouquet had given up the office of procureur-general, which would give him the privilege of a trial by the Parliament. He was accordingly induced to sell his office. In the meanwhile he had bought the port of Belle Isle, which he fortified at great expense, and he had built a palace at Vaux which anticipated the royal magnificence of Versailles. In Aug., 1661, the king attended a *fête* at Vaux, which had been prepared at an enormous expense. But for the intercession of Anne of Austria Louis would have arrested his host in the midst of the festivities. Hardly three weeks passed, however, before he was arrested at Nantes. Charged with malversation in office and rebellion, the alleged evidence of which was procured mainly from papers found in his palace, he was finally sent to the Bastile. He showed fortitude in his imprisonment, and replied with spirit to his accusers, but the verdict was against him, and he was sentenced to perpetual banishment and confiscation, a sentence which the king commuted to imprisonment for life. He was confined at the fortress of Pignerol under the care of Saint-Mars, afterward the jailer of the Man with the Iron Mask, with whom Fouquet is sometimes wrongly identified. He wrote a number of devotional works during his imprisonment, and died at Pignerol, Mar. 23, 1680.

F. M. COLBY.

Fouquier-Tinville, -tăn'veel', ANTOINE QUENTIN: revolutionist; b. at Hérouel, France, 1747; studied law in Paris, where he became *procureur* (attorney) to the Châtelet, an office which the ruin resulting from spendthrift and licentious habits forced him to sell; was reduced to the extremes of want, but secured a humble position in the bureau of police as a reward, it is said, for some flattering and commonplace verses addressed to the king. At the outbreak of the Revolution he joined the violent faction, was conspicuous on the day of the storming of the Bastile, and was soon afterward made *commissaire* of his district (St.-Merry). Danton, Robespierre, and other prominent radicals became his friends, and in the spring of 1793 he was appointed a juror to the revolutionary tribunal, where his effectiveness in carrying out the will of the committee of public safety caused his advancement to the position of director of the jury and then of public prosecutor. Regarding himself as an instrument of the Terror, "the axe of the convention," as he afterward said, he was absolutely pitiless in the administration of his office, condemning his friends and patrons with the rest and heeding neither bribes nor entreaties. He condemned both Hébert and Danton, but did not long survive Robespierre. By order of the convention he was imprisoned Aug. 1, 1794, charged with having caused the death of a great number of persons without regard to the principles or even the forms of justice. Judgment had been passed on sixty or eighty persons in the course of three or four hours without observing the legal forms, and many were sent to the guillotine against whom no deposition had been made. Fouquier replied that he was but the instrument of the convention, which, accordingly, was responsible for his acts. He was guillotined May 7, 1795. F. M. COLBY.

Fourcroy, foor'krwaa', ANTOINE FRANÇOIS, Comte de: chemist and politician; b. in Paris, France, June 15, 1755; became M. D. in 1780; Professor of Chemistry at the Jardin du Roi 1784–1809; admitted to the Academy of Sciences 1785; member of the National Convention 1792, and of the Committee of Public Safety 1794; of the Council of Ancients 1795; appointed Minister of Public Instruction Sept. 15, 1802. D. in Paris, Dec. 16, 1809. *System of Chemistry* (11 vols. 8vo) was issued in 1801, *The Philosophy of Chemistry* in 1792.

Foureau, FERDINAND: See the Appendix.

Fourier, foo'ri-ā', FRANÇOIS MARIE CHARLES: the founder of the social system called Fourierism; b. in Besançon, France, Apr. 9, 1772, and educated in the college of his native city. He had both talent and inclination for studies, especially for mathematics, music, geography, and natural history, but when he was eighteen years old his father put him into the office of a merchant in Lyons as a clerk, and commerce became his business in life, very much against his will. In 1793 he inherited a fortune from his father, but lost it the same year on account of the revolutionary disorders in Lyons, in which he became entangled. He was imprisoned first in Lyons, then in Besançon, and he escaped only by becoming a dragoon in the Revolutionary army. Having been discharged from the military service in 1795 on account of ill-health, he returned to his commercial pursuits. He led a very retired life, held always inferior positions, and had only miserable salaries. In his few leisure hours he wrote his books, and with his scanty spare money he published them. They made no sensation; they hardly attracted any attention, and yet every single day of his life, on returning home from his office, he expected to find some enthusiastic millionaire waiting for him, ready to invest his millions in a social experiment according to the new theory. His first book, *Théorie des quatre mouvements et des destinées générales*, was published in 1808; his second and most important, *Traité de l'association domestique agricole*, in 1822; and a sort of compendium of both, *Nouveau monde industriel et sociétaire*, in 1829; but they found only very few readers. It was not till 1831, when the social schemes of Saint-Simon and of Robert Owen were much discussed, that Fourier attracted any attention for his own ideas by his savage attacks on these two reformers, *Pièges et Charlatanisme des Deux Sectes Saint-Simon et Owen, promettants l'Association et Progrès.* From that time several talented disciples gathered around him—Madame Clarisse Vigoreaux, Victor Considérant, Cantagrel, Hennequin, and Mennier. A monthly paper, *La Phalange*, was issued, and later on even a weekly, *La démocratie pacifique.* In England and the U. S. Fourierism found warm adherents in Hugh Doherty and Albert Brisbane, and practical experiments which had but short life were made both in France and America, the community of BROOK FARM (*q. v.*) being the most noted of these attempts in the U. S. from the eminence of many of its members and advocates. This, like most of such experiments, proved a failure. Fourier died in Paris, Oct. 10, 1837.

The negative side of Fourier's writings, his criticism, is very brilliant. It is bitter, but it is acute, often strikingly true, and always full of noble suggestions. But the positive side of his system is theoretically a failure, and where it also has proved a failure practically the reason is hardly that the experiments have been made with insufficient means, but that the fundamental idea is incompatible with human nature and human destiny. Fourier considers civilization in its present form as the root of all vices and the cause of all miseries; and his views and arguments on this point carry a kind of conviction with them in all their critical details. But the remedy he prescribes, his ideal of a new civilization, his social system, is fantastic, and, what is worse, no remedy at all. Its speculative part, the foundation of the system in the nature of the universe and the human soul, is awkward and insufficient, and its practical part, the phalanstery, where 1,800 people live, work, and enjoy together in one building, is a dream which perhaps would do away with much vice and misery, but which certainly would also do away with much virtue and all heroism. In order to gain freedom in a comfortable but narrow sense of the word, Fourier cuts it off in its large and dangerous but inspiring sense. In order to secure to each individual a certain amount of enjoyment, he cuts off from mankind the prospect of an infinite degree of happiness. In order to get rid of the errors, crimes, and horrors in which human destiny is involved, he lowers this destiny to an eating, drinking, dancing, and sleeping mediocrity. He is not at war with morals and religion, but he has no use for them. He acknowledges property as a reward to labor and talent, but does not understand it as a necessary compliment to the human personality. His phalanstery is the monastery of the Middle Ages revived. To some people it means an asylum, but to others an iron cage. As a critical ferment, however, the value of the works of Fourier and his disciples is considerable. See his complete works (6 vols., 1840–46; new ed. 1870); also Victor Considérant, *Destinée Sociale* (1835); Pellarin, *Charles Fourier, sa vie et sa Théorie* (5th ed. 1871). Revised by F. M. COLBY.

Fourier, JEAN BAPTISTE JOSEPH, Baron: mathematician and natural philosopher; b. at Auxerre, France, Mar. 21, 1768; was a moderate friend of the popular cause in the Revolution, but was twice imprisoned by the ruling party. He was subprofessor in the Polytechnic School 1794–98; accompanied Bonaparte to Egypt as savant in 1798; was prefect of Isère at Grenoble Jan., 1802–15; in 1816 was admitted to the Institute, in 1817 to the Academy of Sciences, and to the Académie Française in 1827. The same year he was president of the council of the Polytechnic School. D. at Paris May 16, 1830. His *Théorie Analytique de la Chaleur* was published in 1822, and he left an *Analysis of Determinate Equations*, published in 1831.

Fourier, PIERRE, known as THE BLESSED PETER FOURIER: b. at Mirecourt, in Lorraine, Nov. 30, 1565; became a Premonstratensian monk, and in 1595 parish priest of Martaincourt, where he founded the congregation of Notre Dame (see NOTRE DAME, CONGREGATION OF), or "Ladies of the Congregation"; and soon after instituted a reform in the Premonstratensian order. D. at Gray, Dec. 9, 1640, and was beatified 1730.

Four Lakes: a chain of lakes in Dane co., Wis., discharging their waters into Catfish river. They are situated in a beautiful and fertile region. First Lake is 3 miles long and 2 miles wide. Second Lake, the next above, is rather longer. Third Lake (Lake Monona) is 6½ miles long and 2 broad. Fourth Lake (Lake Mendota) is the highest; it is 6 miles long and 4 broad. Between the last two lakes stands

Madison, the capital of the State. These lakes are deep, clear, and cold, and are fed largely by springs.

Fournet, foor'nā', VICTOR; scientist; b. at Paris, May 15, 1801. Was educated at the French School of Mines: graduated doctor of science, and rendered great services to dynamical geology, metallurgy, and mineralogy; demonstrated *Fournet's law*, establishing the exact order of the metals as regards their "sulphurability"; was an industrious meteorologist and observer of physical phenomena; introduced great improvements in the treatment of lead ores; was a member of many learned societies, and author of scientific papers of value. D. at Lyons, Jan. 8, 1869.

Fournier, PAUL EUGENE LOUIS: See the Appendix.

Fournier, TÉLESPHORE: Canadian jurist; b. at St. François Rivière-du-Sud, Montmagny, P. Q., in 1823, and educated at Nicolet College. He was admitted to the bar in 1846, appointed queen's counsel in 1863, and has been president of the general council of the bar of Province of Quebec. He was one of the editors of *Le National* newspaper, Quebec, 1856–58, and entering politics was Minister of Inland Revenue 1873–74, Minister of Justice 1874–75, and the latter year became Puisne Judge of the Supreme Court of Canada. He sat in the Quebec Assembly 1871–73, and in the Parliament of Canada for a few years preceding his elevation to the bench. D. May 10, 1896. NEIL MACDONALD.

Fourth: in music, an interval comprising four degrees of the scale, or the distance, e. g., from C to F, D to G, etc. Fourths vary in quality or compass according to their place on the scale, numbering from four to six semitones. They are regarded as threefold—viz., the perfect containing two whole tones and one semitone; the diminished or imperfect, one whole tone and two semitones; and the augmented three whole tones; thus:

In harmony, the fourth is regarded as a consonance when it occurs as the complement of the perfect fifth, as in the second inversion of the triad. In other cases it is treated as an imperfect dissonance. See INTERVAL.

Revised by DUDLEY BUCK.

Fourth Dimension: See GEOMETRY.

Fourth Estate: a term first bestowed in Germany (*vierter Stand*) upon the people standing politically and socially below the THIRD ESTATE (*q. v.*), or citizen class. From the fourteenth century to the end of the eighteenth the representative assemblies in France were made up of three estates: first, the clergy; second, the nobility; and third, the burghers or citizens. In the time of the French Revolution of 1789 a class below that of citizens came forward into great prominence; and early in the nineteenth century it became evident that henceforth it must be counted upon as a political power. Louis Philippe, the "Citizen King," was regarded as the personification of the third estate, and his overthrow was very largely brought about by the stratum of society still lower. Louis Napoleon, by means of universal suffrage, established his power mainly on the basis of the fourth estate. Since the Revolution of 1848 the class so denominated has everywhere received more or less political power mainly through the general extension of the suffrage and in every modern government it has become an element of growing importance. The fourth estate has strong feelings in regard to great questions involving the good of humanity; and, though incapable of nice discriminations, it often turns the political scale by the earnestness of its conviction and the energy of its action. To direct and enlighten its opinion and action in regard to great subjects is one of the most important functions of the scholar and the statesman. To direct its action in regard to matters of medium or subordinate importance is the favorite function of the political demagogue. C. K. ADAMS.

Fourton, MARIE F. O., de: See the Appendix.

Fouvent-le-bas, foo'vaăn'le-baa': a hamlet of France; department of Haute-Saône. In 1800 Cuvier discovered in the vicinity a great number of fossil bones of quadrupeds, and in 1827 Thirria determined some of these bones as remains of the rhinoceros, elephant, hyæna, and lion.

Fowl [M. Eng. *foul, fuhel, fugel* < O. Eng. *fugol*: O. H. Germ. *fogal* > Mod. Germ. *Vogel*: Goth. *fugls* < Teuton. **fuglos*]: a word which, in its original meaning as a synonym of *bird*, is antiquated and nearly obsolete, except as used to designate domesticated birds of the sub-class Cursores and order *Gallinæ*. This order contains, besides the common domestic fowl (*Gallus domesticus*), the peacock, guinea-fowl, turkey, etc., all of which are noticed under the proper heads. There is reason to believe that the domestic fowl is the descendant of more than one recognized species of the genus *Gallus*, all, however, of Asiatic origin. Among these are the *Gallus giganteus*, or Kulm fowl, a large bird of India and the Eastern Archipelago; *Gallus sonneratii*, a spirited fowl of Hindustan; *Gallus æneus, furcatus*, and *bankiva* of the Archipelago, and others; but there is very good reason to believe that they are all of one stock, since the domestic fowl, like the pigeon, has a remarkable tendency to develop strongly marked varieties in breeding.

The domestic fowl was well known to the Greeks; to the Romans, who regarded it as sacred to Mars; to the Egyptians, as their wall-paintings show; to the Etruscans; and, as Cæsar says, to the ancient Britons also. There are innumerable breeds and varieties, among which may be mentioned the Dorking, the game-fowl, the black Spanish, the tall Chinese breeds, the Polish, the Crèvecœur, the Houdan, the little Bantams, the Leghorn, etc. They are valued for the number and excellence of their eggs, and for their flesh, which is excelled by that of no domestic bird except the turkey. The breeds differ much in color, disposition, hardiness, size, and fattening and laying qualities.

The cock is said to have been the emblem of the ancient Gauls, though the tradition does not rest on authority, and is supposed to have been a mere play of words between the Latin *gallus*, a cock, and Gallus, a Gaul; the cock was placed, after the Revolution, on the ensigns of France. It is introduced by artists among the emblems of our Lord's passion, in allusion to St. Peter's sin, and for the same reason it is St. Peter's emblem as the lion is the emblem of St. Mark. Among the early Christians it was represented on tombs as an emblem of the resurrection—the herald of light after the night of death; also as a symbol of vigilance. See GALLINÆ and POULTRY.

Fowler, CHARLES HENRY, D. D., LL. D.: clergyman; b. in Burford, Canada, Aug. 11, 1837; removed with his parents to the U. S. in 1840; graduated at Genesee College, New York, in 1859, and studied at Garrett Biblical Institute, Evanston, Ill. In 1861 he entered the Methodist ministry, preaching in Chicago, Ill., until 1872, when he was chosen president of the Northwestern University at Evanston, Ill. Editor of *Christian Advocate*, New York, 1876–80; appointed secretary of the mission society June, 1880; elected bishop 1884.

Fowler, HENRY HARTLEY, M. P., P. C.: financier and public man; b. at Sunderland, in the county of Durham, England, in 1830; son of the Rev. Joseph Fowler, a prominent Wesleyan minister; educated at Woodhouse Grove School and St. Saviour's School, Southwark; mayor of Wolverhampton 1863, which borough he represented in Parliament 1880–85; Under-Secretary for the Home Department 1884; financial secretary of the Treasury in Mr. Gladstone's ministry of 1886; created privy councilor 1886; president of the local government board in Mr. Gladstone's cabinet 1892. Mr. Fowler has attained his chief distinction as a financier.

Fowler, Sir JOHN, Bart., LL. D., K. C. M. G.: past president of the Institute of Civil Engineers; b. at Wadsley Hall, Sheffield, England, in 1817. After completing his school course he became a pupil of Mr. J. Towlerton Leather, a well-known hydraulic engineer, and was first employed upon the Sheffield water-works. Upon leaving Mr. Leather he was assistant upon several lines of railway, among them the London and Brighton Railway. He was then made resident engineer of the Stockton and Hartlepool Railway, and after its completion remained for two years as general manager and locomotive superintendent. In 1844, at the age of twenty-seven, he became chief engineer of the Manchester, Sheffield, and Lincolnshire lines, embracing very heavy work of every description. He then removed to London, and was continuously employed on important works in Great Britain and elsewhere. Mr. Fowler's principal works are the Metropolitan underground railways of London and their connections. He built a great number of important railway systems, docks, river and harbor works, and reclamation works. He was for eight years consulting engineer to the Government of Egypt, visiting that country every year. With his younger associate, Sir Benjamin Baker, he completed in 1890 the Forth bridge, the largest work of the kind yet constructed, upon the completion of which he was made a baronet. In 1855 he was made a commander of the order of SS. Michael and George "for important services to Her Majesty's Government in Egypt." He became a member of the Institution of Civil Engineers in 1844, and was president in 1866. D. in London, Nov. 21, 1898. WM. R. HUTTON.

Fowler, LYTTLETON: a minister of the Methodist Episcopal Church South; b. in Smith City, Tenn., Sept. 12, 1802; was licensed to preach in Kentucky Sept. 30, 1826. After filling responsible stations in Kentucky, Tennessee, and Alabama, he went in 1833 as missionary to Texas, and in 1838 was made superintendent of the Texas mission, which extended all over the republic. He was a delegate to the General Conference which met in New York in 1844, and was a member of the Louisville convention in 1845, at which the M. E. Church South was organized. D. in Texas, Jan. 19, 1846. He was an eloquent and a successful preacher.
Revised by S. M. JACKSON.

Fowler, ORIN: Congregational minister; b. at Lebanon, Conn., July 29, 1791; graduated at Yale 1815; entered the Congregational ministry; became a missionary in the West; settled in 1819 as pastor at Plainfield, Conn.; in 1831 at Fall River, Mass.; often in the State Legislature; resigned his pastoral charge in 1848, and was in Congress 1848–1852; distinguished as a temperance and anti-slavery orator; author of a treatise on *Baptism* (1835); *Historical Sketch of Fall River* (1841; 2d ed. Fall River, 1862). D. in Washington, D. C., Sept. 3, 1852.

Fowler, ORSON SQUIRE: phrenologist; b. at Cohocton, Steuben co., N. Y., Oct. 11, 1809; graduated in 1834 at Amherst College, and with his brother, L. N. Fowler (b. June 23, 1811; d. Sept. 2, 1896), became widely known as a lecturer, and as writer, editor, and publisher of books and periodicals upon phrenology, health, self-culture, education, and social reform; retired in 1863 from his business in New York; removed to Boston, Mass., and continued to write and lecture; was the author of numerous well-known works upon the subjects indicated above. D. near Sharon Station, Conn., Aug. 18, 1887.

Fowler, SAMUEL, M. D.: b. near Newburg, N. Y., Oct. 30, 1799; studied medicine at Penn Medical College of Philadelphia; was licensed in 1800, and began to practice at Hamburg, N. J.; after a few years removed to Franklin, N. J. He took an active part in politics, representing his county in the upper branch of the State Legislature, and afterward his State in the 24th and 25th Congresses, during the administration of Gen. Jackson, of whom he was a warm supporter and one of the earliest friends in New Jersey. As a mineralogist and geologist he was regarded by men of science as among the first in the country; was made a member of the Geological Society of Pennsylvania and of the New York Lyceum of Natural History; an honorary member of the Literary and Philosophical Society of New Jersey, and corresponding member of the Academy of Natural Sciences of Philadelphia; was also an honorary member of the scientific societies of London and Dublin, and others. In 1825 he published in *Silliman's Journal of Science*, vol. ix., *An Account of some New and Extraordinary Minerals Discovered in Warwick, Orange co., N. Y.*; in 1832, in the same journal, vol. xxi., *An Account of the Sapphire and other Minerals in Newton Township, Sussex co., N. J.*; contributed to Gordon's *Gazetteer and History of New Jersey* an article on *The Franklinite, Red Oxide of Zinc, and other Minerals found in the Valley at the Foot of the Hamburg Mountains*; also a notice of the geology and mineralogy of the same region, for Cleaveland's *Mineralogy*. The rare mineral fowlerite was discovered by and named for him, and the iron and zinc ore franklinite is supposed to have been so called by him; he made it known to eminent naturalists in Europe, and awakened an interest in it which resulted in its successful development and manufacture. D. at Franklin, N. J., Feb. 20, 1844.

Fowler, WILLIAM CHAUNCEY: educator and author; b. in Clinton, Conn., Sept. 1, 1793; graduated at Yale in 1816; was tutor 1819–23; pastor of a Congregational church at Greenfield, Mass., 1825–27; Professor of Chemistry and Natural History in Middlebury College, Vermont, 1827–38; Professor of Rhetoric and Oratory in Amherst College 1838–43; a son-in-law of Noah Webster, and editor of the University edition of Webster's *Dictionary* (New York, 1845); author of a treatise on *The English Language* (1850); of two English grammars; of *The Sectional Controversy* (1863); *Chauncey Memorial* (1856); *History of Durham, Conn.* (Hartford, Conn., 1866), etc. Resided in Durham, Conn., after 1858, and there died Jan. 15, 1881.

Fowlerite: crystallized rhodonite from Franklin, N. J.

Fowler's Solution [named from Dr. Thomas Fowler, of Stafford, England (1736–1801), its inventor]: a solution of arsenite of potash in water, flavored and colored with compound tincture of lavender. Each fluid drachm contains the equivalent of half a grain of arsenious acid. The dose is five or ten drops once, twice, or thrice daily. It is used in many diseases, especially skin diseases and malarial fevers and their sequelæ, and is sometimes very useful in epilepsy and neuralgia. It is a powerful tonic, and should be used only under the eye of a competent physician.

Fox [M. Eng. *fox* < O. Eng. *fox*: Mod. Germ. *Fuchs*]: any one of those members of the family *Canidæ* which are externally distinguished by a slender muzzle, vertical pupil, and an elongated bushy tail. Several distinct genera are thus confounded which differ from each other in some remarkable characters. Of these forms one genus (*Vulpes*) is common to the entire northern hemisphere, and has also numerous representatives in Asia and Africa. The most familiar species is the common or red fox of Europe and North America, and embraces several varieties, of which the most characteristic is the prairie or long-tailed fox of the Southwestern U. S. Another related species, of smaller size, is the swift or kit fox (*Vulpes velox*) of the Western prairies. A third congeneric species with strongly marked characters is a native of the Arctic circle, and has hairy feet, whence it is called *Vulpes lagopus*. The genus *Vulpes* is very closely related to *Canis*. Another genus (*Urocyon*) has much external similarity to *Vulpes*, but is distinguished from it by several very important anatomical characters. It is peculiar to North America, and embraces a single well-determined species (*Urocyon virginianus*); but there is an insular and tropical race which is much smaller, and has been considered as a distinct species, and named *Urocyon littoralis*.
Revised by F. A. LUCAS.

Fox, Sir CHARLES: civil engineer; b. at Derby, England, in 1810; urged by friends to follow the medical profession, but studied engineering, and was first employed by Ericsson. At the beginning of the construction of the London and Birmingham Railway Company's line he was appointed its assistant engineer by Robert Stephenson, and remained with the company five years. He drew the plans for the building called the Crystal Palace, in Hyde Park, in which the great industrial exhibition was held in 1851. Constructed the Sydenham Crystal Palace and many extensive railway and engineering works. D. June 17, 1874.

Fox, Rt. Hon. CHARLES JAMES: English statesman; the second son of Henry, Lord Holland, by Georgiana Carolina, daughter of the Duke of Richmond, a descendant of Charles II.; b. in London, Jan. 24, 1749, and educated at Eton and at Hertford College, Oxford. His father, the first Lord Holland, cherished an almost idolatrous fondness for his second son, and he early initiated him into many of the vices of the time, from some of which it afterward proved impossible for Charles James to emancipate himself. His studies were often interrupted. He did not graduate, but traveled 1766–68 upon the Continent, where he acquired a lifelong fondness for Italian literature. In 1768 he took a seat in Parliament for Midhurst, from which borough he was elected before he came of age. In 1770 he became a Junior Lord of the Admiralty, and in 1773 a Lord of the Treasury, whence he was dismissed in 1774 by Lord North on account of his independent spirit. From this time he stood by the side of Burke and the Liberals, and assailed with the most brilliant and effective eloquence the administration of Lord North, foretelling the eventual defeat of the British arms in North America. In 1780 he was chosen to represent Westminster in Parliament. In 1782 he was Secretary of State for Foreign Affairs under the Marquis of Rockingham, and in 1783 was Secretary of State in the Portland ministry. In 1783 he introduced his India bill for the relief of the inhabitants of British India, but the East India Company, the king, and the House of Lords combined to defeat him, and he resigned. He stood again for Westminster, and was elected, but was unseated through the influence of the ministry. He entered Parliament for a Scottish burgh, and punished the offending magistrates of Westminster by a successful suit at law. He now became the prime leader of the Liberal party, from which Burke was so soon to secede; joined heartily in the prosecution of Warren Hastings; opposed with all his powers the policy of Pitt in his interference in continental affairs; supported Wilberforce in his efforts for the abolition of the slave-trade; and hailed from the first the French Revolution as the harbinger of a new era of freedom. Between Napoleon and Mr. Fox there was a mutual respect which amounted almost to a personal friendship. From 1797 to 1802 he absented himself from Parliament completely. In 1806 he entered the ministry as Secretary for Foreign Affairs, and in a personal note addressed to Napoleon offered peace, but did not live to see it effected. D. at Chiswick, Sept. 13, 1806. Though his life was one of great irregularities, his nature was generous, and he endeared himself to all those with whom he was intimately associated. To the consummate excellence of his oratory Burke, Mackintosh, Parr, Franklin, and all the best critics of his time bear the amplest testimony. His political views were always liberal and progressive, always far in advance of his time. His incomplete *History of the Reign of James II.* was published in 1808, and some minor works, besides six volumes of his speeches appeared in 1815. See Adams's *British Orations*, vol. ii. (1884).

Revised by C. K. ADAMS.

Fox, GEORGE: founder of the Society of Friends; b. at Drayton-in-the-Clay (now Fenny Drayton), Leicestershire, England, in July, 1624; the son of pious Christopher Fox, weaver, called among his neighbors "Righteous Christer." His parents were both members of the Church of England. Fox was early bound apprentice to a shoemaker and glazier, but in 1643 abandoned this occupation, and in 1647–48 began itinerant preaching. For this he was repeatedly arrested and imprisoned from 1649 to 1666, but submitted as one ready to lay down his life for his faith. In 1652 he formed congregations in Lancashire. In 1669 he married Margaret, widow of the Welsh judge Thomas Fell, and in 1671 visited America. At Barbados, on this journey, he drew up a paper setting forth the belief of the Friends as to the fundamental doctrines of Christianity. In Mar., 1673, he embarked for England. He was soon imprisoned again in Worcester jail, remained in confinement a year, and was freed through the influence of Sir Matthew Hale. In 1677 and 1681 he visited the Friends in Holland, and established monthly, quarterly, and yearly meetings there. He returned to England, and died in London, Jan. 13, 1690, having continued his public addresses to within a few days of his death. His writings were published in three vols. folio—viz.: 1, *Journal of his Life, Travels*, etc. (1694); 2, *Collections of many Select and Christian Epistles, Letters, and Testimonies written by George Fox* (1698); 3, *Gospel Truth Demonstrated in a Collection of Doctrinal Books given forth by George Fox, containing Principles Essential to Christianity and Salvation held among the People called Quakers* (1706). Consult Sewell's *History of the Quakers*; the *Life* by Marsh (1848), by Janney (1853), and by Watson (1860); C. H. Spurgeon's *George Fox*, an address to the Society of Friends, London (1866); Tallack's *George Fox, the Friends and the Early Baptists* (London, 1868); and Biekley's *George Fox and the Early Quakers* (London, 1884); and for a full account of Fox's writings and publications, Joseph Smith's *Catalogue of Friends' Books*, Barclay's *Apology* (London, 1678); and T. Evans's *Exposition of the Faith of the Religious Society of Friends* (Philadelphia, 1828), for the doctrinal views of Fox and the early Quakers.

Fox, GEORGE L.: actor; b. in Boston, Mass., July 3, 1825. He first appeared at the Tremont theater, Boston, as one of the children in the *Hunter of the Alps*, for the benefit of Charles Kean. When twenty-five years old he played in the *Demon of the Desert* at the National theater in New York. He entered the Union army at the outbreak of the civil war, and served as a lieutenant in the Eighth New York Infantry at the battle of Bull Run. In July, 1861, he left the army, and soon afterward became manager of the Old Bowery theater, New York. In 1867–68 he made an immediate success in New York as the clown in the pantomime *Humpty Dumpty*. He continued to appear in this part until 1876, when he was stricken with paralysis while playing at Booth's theater, New York. D. at Cambridge, Mass., Oct. 24, 1877.

B. B. VALLENTINE.

Fox, GUSTAVUS VASA: naval officer; b. at Saugus, Mass., June 13, 1821; served in the navy 1838–56; entered business; was summoned to Washington Feb., 1861, and sent by President Lincoln in command of an expedition to relieve Fort Sumter, which, crippled in advance by the withdrawal of the Powhatan, was able only to bring off Maj. Anderson's command after the surrender. Made assistant Secretary of the Navy, he discharged the duties of that position throughout the war with great skill, tact, and unselfishness. He planned the capture of New Orleans and the opening of the Mississippi. At the close of the war he was sent on a special mission to Russia. He afterward was in business in Boston. D. at New York, Oct. 29, 1883.

Fox, LUKE: an English navigator who in 1631 commanded an expedition in search of a northwest passage. He discovered Cumberland island and other important points of Arctic America. In 1635 he published an account of his discoveries.

Fox, WILLIAM JOHNSON: orator and political writer; b. at Uggeshall Farm, near Wrentham, England, in 1786. His father was a weaver. The boy gave early evidence of remarkable ability, and was sent to Homerton College, Hackney, then under the care of Dr. Pye Smith, to be educated for the Christian ministry among the Independents. But his opinions led him away from that connection; he became a preacher of Unitarianism, till, departing still further from the accepted belief, he separated from all denominations, and took an isolated position as a rationalist preacher in South Chapel, Finsbury, London. Here he attracted attention by the speculative boldness of his views, his innovations on the ordinary customs of worship, and the secular tone of his discourses. His audiences, though never very numerous, were composed of people remarkable for intelligence and influence on the world of mind. He was a powerful teacher, with a strong infusion of the social agitator. His interest in politics made him a leader among the Liberals. No abler speaker addressed the meetings of the Anti-Corn-Law League; no abler writer took up the pen for the most extreme measures of the "party of progress." His *Letters of a Norwich Weaver Boy*, which were printed in the newspapers, did powerful service. His *Lectures to the Working-classes* were widely read, and did much to prepare the way for present movements. In 1847 Fox was elected to Parliament from Oldham, was defeated in 1852, and re-elected the same year to fill a vacancy caused by death. At the general election in 1857 he was again defeated. D. in London, June 3, 1864. The writings of Fox are comprehensive and vigorous. Three volumes of sermons show what he was as a pulpit-orator; a book on *The Religious Ideas* shows the cast of his philosophic thought. In religious belief he resembled the Transcendental Unitarians. He was a theist and an idealist. The two points of his creed were "the perfection of divinity—the immortality of humanity." See the memorial edition of his works (12 vols., 1865–68).

Foxborough: town; Norfolk co., Mass. (for location of county, see map of Massachusetts, ref. 5-I); on the Old Colony R. R.; 21 miles S. W. of Boston. It has a public library and public buildings worth $90,000, a large straw-hat and bonnet manufactory, a granite quarry, manufactures of packing-boxes, boots and shoes, and machinery, and several minor industries. Principal business, manufacturing. Pop. of township (1880) 2,950; (1890) 2,933; (1900) 3,266.

Fox(e), or **Fox**, JOHN: b. at Boston, Lincolnshire, England, in 1516; entered Oxford about 1532; chosen a fellow of Magdalen College in 1538; became a Protestant, and in 1545 quietly resigned his fellowship; was tutor to the children of Sir Thomas Lucy, and later (1547–53) to those of the Earl of Surrey; was ordained deacon by Ridley 1550; fearing persecution under Queen Mary, he fled to the Continent in 1534, and lived in deep poverty in Basel; returned in 1559; became a prebendary of Sarum 1563; and died in London, Apr. 18, 1587. He is chiefly remembered as author of the *Acts and Monuments* (London, 1563), known as Fox's *Book of Martyrs*; best modern ed. by John Stoughton (8 vols., London, 1877).

Foxglove: See DIGITALIS.

Foxhound: a variety of the dog, bred principally in Great Britain and Ireland, and by its keenness of scent, speed, and powers of endurance, adapted to the national sport of fox-hunting. The foxhound is from 20 to 22 inches high, close-haired, straight-limbed, with large thin ears and preferably white clouded with black and tan. It is said to have been produced by crosses between the bloodhound, greyhound, and bulldog, but however this may be the breed is now well established.

Fox-hunting: one of the national sports of Great Britain; engaged in to some extent in the U. S. The fox is followed by a pack of from 40 to 120 dogs, and by a large number of gentlemen and ladies on horseback. As they ride in the chase the party are under the charge of a master, the hounds being in the care of a huntsman and "whippers-in" or whips. The bolder members of the hunt leap their horses over fences, gates, and hedgerows, and all feel at liberty, when necessary, to rush headlong through fields of grain and other growing crops. The fox is not shot, but when caught by the dogs the huntsman cuts off his brush (tail), pads (feet), and mask (face), which are given as trophies to those who may be present, or "in at the death," as it is called. The flesh is cut up and given to the dogs, to be devoured on the spot.

Fox Indians: See ALGONQUIAN INDIANS.

Fox Islands: Pacific Ocean. See ALEUTIAN ISLANDS.

Fox River: a stream rising in Green Lake co., Wis. Taking a S. and S. W. direction, it approaches to within $1\frac{1}{2}$ miles of the Wisconsin river, with which it is connected at Portage City by a canal. It then flows by a circuitous course N. and N. E. to Green Bay, Wis., into which it falls at the town of that name. The navigation of this river has been improved by jetties, and a canal between it and the Wisconsin forms the connecting link of the great water-route which leads from the Mississippi by way of Wisconsin river, the Upper Fox, Lake Winnebago, and Lower Fox river to Green Bay, and thence by way of the Great Lakes to the Atlantic Ocean.

Fox River: a stream which rises in Waukesha co., Wis., and flows S. and S. W., emptying into the Illinois river at Ottawa, Ill. It furnishes abundant and well improved water-power.

Fox Shark, or **Thresher**: the *Alopias vulpes*, a shark of the Atlantic and Pacific; 12 to 18 feet long, the tail

Fox shark.

about as long as the body. Its food consists of small fishes, and while it has been reputed to attack and thresh the whale with its tail, such reports are erroneous.

Foy, MAXIMILIEN SÉBASTIEN: general; b. at Ham, France, Feb. 3, 1775; entered the army in 1791; served with distinction in the republican wars; was in Massena's and Moreau's Swiss and German campaigns, but his known coldness toward Napoleon tended to check his promotion. He was made a general of division; served at Waterloo; represented the department of Aisne in the Chamber of Deputies 1819, where he appeared in a new *rôle*, that of a liberal orator. D. at Paris, Nov. 28, 1825. The people subscribed freely for his children, whom he left poor. He left *Speeches* (2 vols., 1826) and *History of the Peninsular War* (unfinished, 4 vols., 1827). C. H. THURBER.

Foyers, fi'erz, or **Fyers**: a river of Scotland; rises in the Monadleadh Mountains in Inverness-shire, and after running 12 miles N. falls into Loch Ness. It forms two falls—an upper one of 30 feet, and a lower one of 90 feet. The latter is one of the finest in Great Britain.

Foyle: a river of Ireland; formed at Lifford by the junction of the Finn and the Mourne; after a course of 70 miles it falls into Lough Foyle, an inlet of the Atlantic on the northern coast of Ireland. It is famous for its salmon-fisheries, and is navigable for vessels of 600 tons to Londonderry, 4 miles from the Lough.

Fra Angelico: See FIESOLE, FRA GIOVANNI.

Fractions [from O. Fr. *fraction* < Lat. *frac'tio*, breaking, deriv. of *fran'gere*, *frac'tum*, break]: in arithmetic, a fraction is one or more of a number of equal parts into which a unit or whole number is divided; also, the expression indicating one or more such parts. When the unit or whole is divided into two equal parts, each is a *half*; when into three equal parts, each is a *third*; and so on. Thus *one-half*, *two-thirds*, *four-ninths*, etc., are fractions; they may be written $\frac{1}{2}$, $\frac{2}{3}$, $\frac{4}{9}$, etc. A fraction consists of a *denominator*, which shows how great the parts are, and a numerator which indicates the number of these parts. In the fraction $\frac{5}{6}$ (read *five-sixths*) 6 is the denominator and 5 is the numerator.

Fractions are divided into two classes—*vulgar* or *common fractions* and *decimals*. Vulgar fractions are those in which the denominator is expressed; decimals are those in which the denominator is simply indicated. The denominator of a common fraction may be any quantity whatever; the denominator of a decimal is always some power of 10. The denominator of a decimal may be written out in full, in which case it is a decimal fraction, which differs in no respect from a common fraction. See DECIMAL and DECIMAL FRACTION.

VULGAR FRACTIONS.—Vulgar fractions are expressed by writing the numerator over the denominator, with a line between them, as $\frac{7}{8}$. This is one of the methods of indicating division; a fraction is, in fact, equivalent to the quotient of the numerator by the denominator.

The two parts of a fraction are called *terms*, and according to their relative values the fraction is said to be *proper* or *improper*; if the numerator is less than the denominator, the fraction is *proper*; if the numerator is greater than the denominator, the fraction is *improper*. A proper fraction is always less than 1, and an improper fraction is always greater than 1. It may happen that the terms of a fraction are equal; in this case the expression is equal to 1, and is fractional only in *form*.

Fractions are *similar* when they have a common denominator—that is, when they have the same unit; they are *dissimilar* when they have different units. Thus $\frac{3}{7}$ and $\frac{5}{7}$ are similar—$\frac{3}{7}$ and $\frac{4}{5}$ are dissimilar. Dissimilar fractions can be made similar as follows: find the least common multiple of the denominators for a common denominator of the required fraction; divide this by the denominator of each fraction, and multiply the quotient by the corresponding numerators for the numerators of the required fraction. This transformation, as well as many others, depends on the general principle that we may perform the same operation on both terms without changing the value of the fraction.

Fractional expressions are those that contain a fraction in any form. They may be mixed, complex, or compound. A mixed fraction, or mixed number, is composed of an integral and a fractional part, as $3\frac{1}{8}$, $5\frac{2}{7}$. A complex fraction is one in which at least one of the terms is fractional, as $\frac{3\frac{1}{2}}{5}$, $\frac{2\frac{1}{4}}{3\frac{1}{5}}$, $\frac{3}{5\frac{1}{7}}$. A compound fraction is a fractional part of a fraction or mixed number, as $\frac{1}{2}$ of $\frac{2}{5}$, $\frac{1}{3}$ of $5\frac{1}{4}$. Any one of these may be reduced to the form of a simple fraction—that is, to a form in which both terms are entire—by means of the general principle already given.

ALGEBRAIC FRACTIONS.—In algebra a fraction is any indicated quotient of two quantities; also, the expression by which the quotient is indicated. A rational fraction is a function of a variable x, which may be reduced to the form

$$\frac{Nx^m + N'x^{m-1} + \ldots + K}{A'x^n + Bx^{n-1} + \ldots + K'}.$$

If m is not less than n the fraction may be reduced by division to the form

$$X + \frac{A''x^{n-1} + B''x^{n-2} + \ldots + K''}{A'x^n + B'x^{n-1} + \ldots + K'},$$

in which the entire part is either a rational function of x, or a constant. The fractional part can be resolved into *partial* fractions—that is, fractions whose denominators are either binomial factors of the first degree with respect to x, or some integral power of such factors—whenever the denominator can be resolved into such factors. This resolution is of much use in the integral calculus. The following are the methods of resolving fractions of this kind into partial fractions:

1. *When the Binomial Factors of the Denominator are Real.*—Write the given fraction equal to the sum of as many partial fractions as there are units in the highest exponent of the variable in the denominator, whose numerators are constants to be determined, and whose denominators are the different powers of the factors of the first degree, from the m^{th} to the 1st inclusive, m being the number of times that any factor enters; then clear the equation of denominators, and equate the coefficients of the like powers of the variable in both members; from these equations find the values of the constants, and substitute them in the assumed partial fractions: the resulting fractions will be the

partial fractions required. Thus let it be required to separate the fraction

$$\frac{x^3 + x^2 + 2}{x^5 - 2x^3 + x}$$

into partial fractions. The factors of the denominator are $x(x+1)^2$ and $(x-1)^2$. Hence by the rule

$$\frac{x^3 + x^2 + 2}{x^5 - 2x^3 + x} = \frac{A}{x} + \frac{B}{(x+1)^2} + \frac{C}{x+1} + \frac{D}{(x-1)^2} + \frac{E}{x-1}.$$

Clearing of denominators, and equating the coefficients of like powers of x, we obtain a set of equations from which we find $A = 2$, $B = -\frac{1}{2}$, $C = -\frac{1}{2}$, $D = 1$, and $E = -\frac{3}{4}$. Hence

$$\frac{x^3 + x^2 + 2}{x^5 + 2x^3 + x} = \frac{2}{x} - \frac{1}{2(x+1)^2} - \frac{1}{2(x+1)} + \frac{1}{(x-1)^2} - \frac{3}{4(x-1}.$$

2. *When the Factors of the Denominators are all Imaginary.*—In this case we suppose the denominator to be resolved into factors of the second degree, each of which, when placed equal to 0, will give two imaginary roots. We then write the given fraction equal to the sum of as many partial fractions as there are single factors of the second degree in the denominator, their numerators being of the form $Mx + N$ (M and N being constants to be determined), and their denominators being the different powers of the factors of the second degree from the m^{th} to the 1st inclusive, m being the number of times any factor is taken. We then proceed as before.

VANISHING FRACTIONS.—A vanishing fraction is a fraction that reduces to $\frac{0}{0}$ for a particular value of the arbitrary quantity that enters it. Thus

$$\frac{x^2 - a^2}{x^3 - a^3} = \frac{(x-a)(x+a)}{(x-a)(x^2 + ax + a^2)}$$

is a vanishing fraction, which reduces to $\frac{0}{0}$ when $x = a$; the common factor which produces this result is $x - a$. If we strike out this factor, and then make $x = a$, we find for the true value of the fraction,

$$\frac{a + a}{a^2 + a^2 + a^2} = \frac{2a}{3a^2} = \frac{2}{3a}.$$

Revised by S. NEWCOMB.

Fracture [from O. Fr. *fracture* < Lat. *fractu'ra*, deriv. of *fran'gere, frac'tum*, break]: (1) In mineralogy, the appearance of the fresh surface when a mineral breaks, disclosing its texture, and furnishing a characteristic by which it may be identified. Thus the fracture is said to be *even* when it forms a face or plane of some extent; *uneven*, when the surface is rough and unequal; *conchoidal*, or shell-like, when concave on one side and convex on the other; *splintery*, when the surface presents the appearance of numerous thin-edged scales; and *hackly*, when covered with numerous fine sharp points or inequalities. (2) In surgery, the term fracture is used to indicate a break, or solution of continuity, occurring in osseous tissue, or in rare cases in cartilaginous tissue partly ossified. The separation, in early life, of two portions of the same bone, held together by cartilaginous tissue, is not strictly accounted a fracture, but is known as epiphyseal separation. Fractures may be *simple, compound, complicated* or *comminuted*; *complete* or *incomplete*; *oblique, transverse, spiral*, or *longitudinal*. By *simple* fracture is meant one in which no wound exists admitting air to the seat of fracture. A *compound* fracture is one in which such a wound does exist. A *complicated* fracture is one in which some other serious injury is inflicted, at or near the site of the fracture, other than the rupture of the osseous tissue, or in which, from the situation of the rupture, the healing process can not progress as favorably as is usual; as when a large blood-vessel or nerve-trunk is torn by the broken bone, or when the fracture extends into a joint-cavity. A *comminuted* fracture is one in which the bone is broken into several small pieces at the point of rupture, and is rarely produced except by direct violence, as by a blow or crushing force. A *complete* fracture is one in which the rupture extends through the whole thickness of the bone, while if only a portion of the fibers is broken, as sometimes happens in children, the fracture is called *incomplete*, or the "green-stick fracture" of some writers, from its resemblance to the fracture produced by bending a stick of green wood until some of the fibers give way. The terms *transverse, oblique, spiral*, and *longitudinal* refer to the direction of the rupture in relation to the long axis of the bone, the great majority of the fractures of the long bones belonging to the second class. The term *stellate* is applied to a series of fractures radiating from a center, as seen sometimes in fracture of the skull from a wound produced by a pointed instrument. When the line of fracture extends into a joint it is spoken of as *intra-articular*; when its limits are quite within those of a joint-cavity it is *intra-capsular*.

Causes of Fracture.—These may be *external*, from violence adequate to break a normal bone, or *internal*, the bone being too fragile to resist ordinary forces. External causes embrace *direct violence*, where the rupturing force is applied opposite the point where the bone breaks (as a blow or crushing force which fractures the bone at the point of contact); and *indirect* violence, where the bone is bent beyond the power of its elasticity to restore itself, and gives way, usually at some distance from the point of application of the fracturing force (as when a fall upon the shoulder fractures the collar-bone). The skull and pelvis are sometimes broken at points more or less opposite to that at which violence has been applied; this is known to surgeons as fracture by *contre-coup* (counter stroke). *Muscular* force is generally acknowledged as a cause of fractures, especially in particular situations—e. g. fracture of the point of the elbow or of the knee-pan. The *internal* or predisposing cause is a brittleness of the bones called "fragilitas ossium," which occurs sometimes in early or middle life as a result of disease (although it may occur in those otherwise healthy), and almost universally in advanced life from the preponderance of earthy and deficiency of elastic matter; this condition is also now well known to obtain among the insane.

The signs of fracture are *pain, swelling*, and *tenderness* (loss of function) at the point of fracture, *change in shape* of the limb, *unnatural mobility, false point of motion*, and *crepitation*, and the fact that when the parts are restored to their proper position they fail to remain there unless supported, though any, or even all, of these signs may be absent. The pain comes from laceration of some nerve-filaments and pressure upon others by the broken bone, or by the blood escaping from torn vessels, which gives rise to the swelling that occurs at first, the subsequent swelling being due to products of inflammation or of the reparative process. The change in shape is due partly to this swelling, and partly to displacement of the broken bones, either by muscular action or by movements of the patient. The unnatural mobility and false point of motion comes of course from the want of continuity of the bone, and the crepitation is a fine grating elicited when the ends of the broken bone are gently rubbed together, and which may be appreciated by the ear or touch. If the fracture be *impacted*—that is, if the broken ends are firmly driven together, as sometimes happens—none of these signs may be present in a marked degree, and some of them, such as crepitation and false motion, not at all.

Fractures generally unite by the deposition of bony material between and around the broken ends of the bone, forming an exception to the rule that prevails for most other structures, that union after rupture is effected by means of fibrous or connective tissue; and the reason is apparent, since fibrous tissue does not form a sufficiently rigid bond of union to enable the bone to perform its functions, as is seen in cases of so-called "ununited fracture," when the union is of a fibrous nature. The union of a simple fracture consists of two processes—one to accomplish a temporary purpose, the other for the permanent union; the former to support and bind together the fragments, while the latter consolidates them. A few days after the fracture the bone, its periosteum (membrane surrounding the bone), and the neighboring tissues pour out a quantity of plastic material around and between the broken ends, which, with the remains of the blood at first effused, gradually hardens, and at the end of the fourth to the eighth week consolidates the fragments. This is called the "provisional callus," and the hardening process continues until it is converted into bony tissue. The plastic material effused *between* the fragments is much slower in ossifying than that which is internal or external to it; and this, which is destined to form the permanent bond of union, is called the "definitive callus." While the definitive callus is forming the provisional callus is gradually being absorbed; and finally, many months after the fracture, the provisional callus entirely disappears, and the fragments are united by the definitive callus alone, which is true bone; and the site of the fracture may be indicated only by a slight enlargement at that point. The union of *compound* fractures is entirely different. In these the provisional callus is almost or quite absent, and the definitive callus is formed by a process of granulation from the ends of the fragments, the granulations being gradually converted into bony tissue. It is a process requiring several months, or sometimes years, and is attended with a greatly increased amount of danger from exhaustion through long-continued suppuration and absorption of purulent material should such occur. The difference in the mode of union seems to be due to the irritation produced by the sources of infection (*germs*) conveyed by the air to the wound.

The *treatment* of fractures consists essentially in restoring the fragments to their original position, and holding them there by some form of rigid apparatus which shall not cause discomfort or injury to the patient. Of course general treatment is to be employed also if the circumstances require; but simple fracture in a healthy individual requires no special medication or system of dieting, as the old modes of practice were wont to inculcate. The rigid apparatus used to retain the fragments in their proper position is called a splint, which consists of two kinds—padded and molded. If the splints are made of straight, inflexible material, they can not be adapted to the irregularities of the limb without more or less padding at certain points; while if made of material which at the time of its application is soft and pliable, it may be molded to the shape of the limb, and, becoming hard and rigid, will serve to support and retain the fragments. Splints of the first variety are made of wood, sheet iron, tin, zinc, etc., while metal, gutta-percha, felt, sole leather, starch, soluble glass, or plaster-of-Paris are used for the second class. Fractures sometimes fail to unite, and are called *ununited* fractures. This may be the consequence of faulty position of the fragments, or of something interposed between the broken ends, impeding union, but it more frequently arises from some constitutional defect. The location of the fracture may prevent union, especially if either fragment be poorly supplied with blood, as in certain fractures of the neck of the thigh-bone, which frequently unite only by fibrous tissue. Ununited fractures may often be made to unite by irritating the parts at the site of fracture, as by rubbing the bones together, drilling them by means of a long needle, or by wiring the bones together. Compound fractures need to be treated according to the strictest tenets of modern aseptic surgery, whose underlying principle is surgical cleanliness. Their successful treatment depends in the main upon due appreciation of the fact that the principal danger to which they are subject is that from blood-poisoning (septicæmia, pyæmia), and that these are due to germs of putrefaction and disease (bacteria) which infest the air, the skin, common dressings, the clothing, and all the surroundings. Scrupulous disinfection of everything in or about the wound, including the skin, the surgeon's hands and instruments, the dressings, and everything which may come in contact with the parts, is the *sine qua non* of success. Under such methods the whole former treatment of these injuries, and the results obtained, have been simply revolutionized.

Revised by Roswell Park.

Fra Diavolo, fraa' dē-aa'vō-lō [Ital., liter., brother devil; *fra*, brother < Lat. *frater* + *diavolo*, devil < Lat. *dia'bolus*]: the Italian sobriquet of Michele Pezza, a Calabrian goatherd; b. at Itri in 1760. He became successively a stocking-weaver, a soldier, a monk (with the name of Fra Angelo), and the leader of a band of atrocious robbers. He took service in 1799 against the French, and held a colonel's commission; was captured by the French and hanged in 1806 as a robber, notwithstanding his pardon and commission from the King of Naples. The Fra Diavolo of Auber's opera has little or nothing in common with the historical character.

Fraga, fraa'gaā: town of Spain; province of Huesca, on the Cinca, 55 miles S. E. of Huesca, in the center of a fertile and well-cultivated plain (see map of Spain, ref. 13–I). It was formerly a fortress, and in 1134 witnessed a victory of the Moors over Alfonso I. of Aragon. Pop. (1887) 7,158.

Fragonard, fraā'gō'naar', Alexander Evariste: historical painter; son of Jean Honoré Fragonard; b. at Grasse, France, Oct., 1780. Pupil of David; Legion of Honor 1819. Was one of the chief "classicists of 1830," and a sculptor as well as a painter. Frescoes in the Louvre, Luxembourg Palace, and Versailles Museum; works in museums at Orleans and Blois. D. in Paris, Nov. 10, 1850.

W. A. C.

Fragonard, Jean Honoré: genre and portrait painter and engraver; b. at Grasse, France, Apr. 5, 1732. Pupil of Chardin and Boucher; Grand Prix de Rome 1752; his work forms a sort of connecting link in the transition from the painting of the eighteenth century to the classicism of the early part of the nineteenth. His pictures are in the museums at Rouen, Nantes, Versailles, Lille, Amiens, Nancy, Marseilles, St. Petersburg, and Madrid, and in the Louvre. His pictures resemble those of Boucher in subject, and his portraits are freely and cleverly painted. D. in Paris, Aug. 22, 1806. W. A. C.

Framingham: a township of Middlesex co., Mass., containing three thriving villages—Framingham Center, South Framingham (*q. v.*), and Saxonville (see map of Massachusetts, ref. 3–H). Framingham Center has the oldest normal school in North America, a soldiers' memorial library building, etc. Pop. of township (1880) 6,235; (1890) 9,239; (1900) 11,302.

Fra Moreale, fraa'mō-rā-aa'lā [Ital., Brother Montreal, so called because he was once a brother in the order of St. John in Jerusalem; but afterward he left it in disgrace]: the title of Montreal d'Albano, a gentleman of Provence who distinguished himself as a condottiere in the service of Louis I., King of Hungary, in his Neapolitan wars (1347–51). After the close of the wars Montreal remained in Naples at the head of a body of brigands, and entered on a course of wholesale brigandage. Being finally driven from Naples, he raised a large company of freebooters, with which he marched against one and another of the petty rulers of Italy. All booty was divided among his followers according to a fixed system. He became the terror of Italy, and the soldiery flocked from every quarter to his service. Bulwer's picture of him in *Rienzi* is not exaggerated. Sienna was forced to give him provisions and free transit, Florence to pay him 28,000 florins, and Pisa 16,000. Montreal contemplated the establishment of a permanent dominion, perhaps with Rome itself for his capital. With a small force he went to Rome, where he was arrested by command of Cola di Rienzi, and beheaded Aug. 29, 1354.

Revised by C. H. Thurber.

Franc [(adapted in spelling to Fr. *franc*) < M. Eng. *frank*, from O. Fr. *franc*, deriv. of Lat. *Francus*, a Frank, the coin at first bearing the Lat. inscription *Francorum rex*, king of the Franks. See Franks]: the unit of account in the monetary system of France, adopted under the republic in 1795; also the silver coin representing the same unit. In the general reform of French metrology which took place in the year above mentioned, the following were the governing principles: (1) to derive the units of measure, weight, and value, mediately or immediately, from the linear unit called the meter, which is the base on which the whole system rests; (2) to derive the higher and lower denominations in each series from the corresponding unit by decimal multiplication and division. The unit of capacity was derived immediately from the basic unit of length; the unit of weight from the unit of capacity; and the unit of value, the *franc*, from the unit of weight. (See Metric System.) The franc is divided into 10 *decimes* and 100 *centimes*; the denomination *decime* has fallen into disuse, but the old division into twenty *sous* of five centimes each is still in common use. The copper coins which represent this value are stamped "*Dix centimes.*" The coinage in silver consists of single francs, pieces of five and two francs, and of fifty and twenty centimes. The gold coins are pieces of five francs, ten francs, twenty, fifty, and a hundred francs. The twenty francs are commonly, but not legally, called napoleons. The copper coins are of ten centimes, five centimes, and a very pretty but rather useless little piece of one centime. The one-centime pieces are hardly seen except at the post-offices.

The monetary system of France was adopted by Switzerland May 7, 1850, and on Dec. 23, 1865, a quadripartite treaty was entered into between France, Belgium, Switzerland, and Italy known as the Latin Union (*q. v.*), which made this system common to all those countries. Austria has assimilated her system to that of France by making her ten-florin piece equal to twenty-five francs. Roumania, Spain, Servia, Bulgaria, and Greece have adopted the equivalent of the franc, though they call it by other names. The weight of the silver franc is five grammes = $77\frac{1}{6}$ grains troy, its value being about nineteen cents U. S. money and $9\frac{1}{2}d$. English money.

The name *franc* did not originate with the monetary system of 1795. It has been in use since the fourteenth century, and applied to coins of very different values both gold and silver, at different times. The legal monetary unit in France before the introduction of the franc was the *livre Tournois* (of Tours). It was slightly less in value than the coin by which it was superseded, eighty-one livres being equal to eighty francs.

Français, Cap: See CAPE HAYTIEN.

Français, fraañ'sā, FRANÇOIS LOUIS: landscape-painter; b. at Plombières, Vosges, France, Nov. 17, 1814. Pupil of Gigoux and Corot; first-class medals, Salon, 1848, Paris Expositions, 1855 and 1867; medals of honor, Paris Exposition, 1878, and Salon, 1890; member of the Institute 1890; officer Legion of Honor 1867. His pictures are notable for fine composition and are truthful in effect. Four works are in the Luxembourg Gallery, Paris. Studio in Paris.

W. A. C.

France: I. A republic of Western Europe, extending over a space of 12° 20' lon.; and from lat. 42° 20' to 51° 5' N. It is bounded N. by the North Sea, the Strait of Dover, and the English Channel, which separates it from England; W. by the Atlantic Ocean; S. by the Pyrenees, which separate it from Spain; S. E. by the Mediterranean; and E. by the Alps. The greatest extension of the country from N. to S. is 600·6 miles, from E. to W. 550 miles; the greatest diagonal, from Finistère to Mentone, is 668 miles. Its area is 204,092 sq. miles (Corsica included), or about $\frac{1}{18}$th part of Europe and $\frac{1}{250}$th part of the land-surface of the earth.

Annexed to France are Corsica and Algeria, the latter comprising a large territory S. of the Mediterranean, with an area of 257,450 sq. miles, of which about 166,000 are actually occupied. The colonies of France are increasing rapidly. France possesses in Africa, besides Algeria, the protectorate of Tunis (about 45,000 sq. miles), Senegal, with the French Sudan, French Guinea or Rivières du Sud, with the protectorate of Futa-Djallon, the Ivory Coast (Grand Bassam, Assinie, etc.), with the protectorate over the Kong country, the settlements on the Slave Coast (Whydah, Kotonou, Porto Novo), with the protectorate of Dahomey, French Congo, Madagascar (with its islands), which was made a colony in the year 1896, as well as Mayotte and the Comoro Isles, Réunion, and Obok at the entrance to the Red Sea; in Asia, the five cities of Mahé, Karikal, Pondicherry, Yanaon, and Chandernagore in Hindustan; in Indo-China, Cochin-China, Tonquin, with the protectorate of Annam and Cambodia; in Oceanica, New Caledonia and dependencies, the Marquesas, the Society islands (under French protection), etc.; in South America, French Guiana; and in the West Indies, Martinique and Guadeloupe, to which must be added two small islands, St. Pierre and Miquelon, situated S. of Newfoundland. The total area of the territories belonging to and protected by France is 2,814,988 sq. miles, with 30,520,293 inhabitants.

II. PHYSICAL GEOGRAPHY. 1. *The Surface.*—The surface of France, considered in general, presents a plane, gently inclined from S. W. to N. W.; that is, from the Alps and the Pyrenees to the Atlantic Ocean. To the E. this plane is cut by the valley of the Rhône, on whose western side rise the Cévennes, from which the waters of the three great basins of France flow in an almost parallel direction. Thus the orographic system of the country is composed of—1, an outer belt of chains, comprising the Vosges, Jura, Alps, and Pyrenees; 2, an inner belt, comprising the Cévennes and their continuations; and 3, the ramifications issuing from the Cévennes, and comprising the group or central plateau separating the basins of the rivers which flow to the Atlantic.

The *Vosges* stretch from N. to S., parallel with the Rhine, for a length of 161 miles. Their summits are rounded and generally covered with turf; now and then the rock juts through. Their sides are clad with magnificent forests of beech and fir. The southern part of the Vosges is the highest; its average elevation is 3,280 feet; the highest peaks are the Ballon de Guebwiller (4,680 feet) and the Ballon d'Alsace (4,100 feet). The northern part, from the neck of Saverne to the group of the Palatinate, rises hardly more than 1,968 feet; the principal passes of this chain are those of Saverne, Ste.-Marie-aux-Mines, Bussang, and the picturesque Schlucht. The Vosges are separated from the Jura Mountains by the pass of Belfort, which forms one of the principal thoroughfares across the French frontier.

The *Jura Mountains* are principally composed of limestone, called Jurassic. Instead of rounded summits there are long, parallel ridges, which support three galleries of plateaus. The general direction of these ridges is a curve concentric with the general curve of the Alps, and on the line of this curve are found the depressions of the lakes of Leman, Neuchâtel, and Bienne. The Jura group rises from France toward Switzerland; its highest peaks are the Crêt de la Neige (5,656 feet), the Reculet (5,630 feet), Mont Tendre (5,518 feet), and the Dôle (5,514 feet); its length, from the Rhône to the Rhine, is 186 miles.

The *Alps*, which form the great arc of a circle, surround Northern Italy on three sides. The French part has a length of about 279 miles, and consists of the Pennine, Graian, Cottian, and Maritime Alps. The Pennine Alps extend from St. Gothard to Mont Blanc, whose highest peak, white with snow, rises 15,776 feet, and surpasses all other mountains in Europe, not only in height, but also in beauty. The Graian Alps contain the Little St. Bernard and terminate at the road of Mont Cenis, which formerly was the principal passage across the Alps, but which has been superseded by the tunnel through Mont Cenis. The Cottian Alps extend to the pyramid of Mont Viso (12,585 feet), and form an acute angle, at whose head stands Mont Thabor (10,535 feet). The Maritime Alps terminate at Col di Tenda, after describing a large arc, with the concavity toward Italy.

Toward Italy the slopes of the Alps are abrupt. In France they project long and powerful arms toward the Rhône—namely, the Alps of Valais, whose nucleus is formed by the Buet; the Alps of Faucigny and Chablais; the Alps of Savoy, with the beautiful group of the Great Chartreuse; the Alps of Dauphiné, which communicate with the Pelvoux and its immense glaciers, whose highest peak is called, quite poetically, La Barre-des-Écrins (13,457 feet), and with Devoluy, a dull and gloomy group; the Alps of La Maurienne; and finally the Alps of Provence, which contain Mont Ventoux in the N., the mountains of Les Maures, with their pine-covered summits, and those of L'Estérel.

The *Pyrenees* are inferior to the Alps in height, extent, and aspect. They extend from W. to E., and to the N. a regular series of buttresses and vales project. The principal peaks are, in the eastern Pyrenees, Canigou (9,137 feet) and the Pigne d'Estats (10,302 feet); in the central Pyrenees, Pic de Carlitte (10,203 feet), Cylindre du Marboré (9,861 feet), Néthou (11,168 feet), the highest peak in the whole chain, Mont Perdu (10,995 feet), and the Pic du Midi de Bigorre (9,436 feet); and in the western Pyrenees, Vignemale (10,820 feet) and Pic du Midi d'Ossau (9,734 feet). The principal passes from E. to W. are the Perthus, the Col du Pla' de Beret, and the Somport.

The main body of the Pyrenees, composed of granite, schist, and limestone, extends over a length of 217 miles, and has a breadth of 62 miles in the center, and of 31 miles at the extremities. From the center proceed the long ranges of hills which separate the valleys of the Gaves. From the Pic de Carlitte issue two secondary chains, the Corbières, of which the southern is high, pointed, and granitic, and the northern flat and calcareous. This chain is continued by the Cévennes, which begin at the neck of Naurouze and extend over a length of 295 miles. They are divided into the southern Cévennes, which are rocky and granitic chains whose principal peak is L'Aigoual (5,139 feet); the central Cévennes, which comprise the mountains of Gévaudan and Vivarais, and whose most remarkable peaks are the Gerbier de Jonc (5,121 feet), the Mézenc (5,820 feet), and the Lozère (5,584 feet); and finally the northern Cévennes, which again are subdivided into the mountains of Lyonnais, Beaujolais, and Charolais, which fall to an average of 1,804 feet.

To the N. the Cévennes are continued by the Côte-d'Or, which produces the finest wine in France, the plateau of Langres, and the Faucilles Mountains, which communicate with the Vosges. N. of the Faucilles Mountains extend the plateaus of Lorraine, L'Argonne, with its famous defiles, and the Ardennes, covered with forests and deeply cut by the streams which traverse them. Between the Ardennes and the sea stretch the plains of Flanders and the fertile and well-cultivated plains of Artois and Picardy, which are continued to the sea by the plains of Caux.

To the W. of Côte-d'Or, whose average height is 1,640 feet, is found a small granitic group, from 2,624 to 2,952 feet high, called Morvan; on account of its strategical position it is considered the citadel of France. Still more westerly, and N. of the Loire, stretches the immense plain of the Beauce, the vast granary of France. Between the Beauce and Finistère are the heights of Perche and Maine, about 1,312 feet high, from which a double granitic range traverses Brittany from E. to W. N. of Maine are the graceful and fertile hills of Lower Normandy, and finally the peninsula of Cotentin, terminating in Cape de la Hague and the high hills inclosing Cherbourg.

Between the Loire and the Garonne are the remarkable summits of the central group which in remote ages separated the gulf of the Seine from that of the Garonne. This group comprises very different chains; the granitic mass of the Margeride, from 3,608 to 5,248 feet high; the mountains of Auvergne, whose highest peak is the Plomb du Cantal (6,094 feet), an old volcano, and in the center the groups of Cézallier and Mont Dore, which contain the Puy de Sancy (6,186 feet), the highest peak in Central and Northern France, and which project toward the N. W., a granitic spur, the mountains of Lower Auvergne, and toward the N. the chain of the Puys, a curious line of old, extinct volcanoes, now covered with verdure, but whose craters are still distinguishable, as are also the immense streams of lava, which in the country itself are called *chéires*. Puy de Dôme (4,805 feet) and Puy de Pariou are the most remarkable of these volcanoes—the one on account of its height, the other on account of its form. With the mountains of Lower Auvergne connect the granitic mountains of Limousin, which attain their greatest height in Mont de Meymac (3,207 feet) and Mont Odouze (3,129 feet), and which from that point slope down through the sterile plateau of Millevaches to Mont Jargeau (3,116 feet). The central group contains several secondary ridges; to the N., a chain whose elevation seldom surpasses 3,280 feet, though in a few points it reaches 5,248 feet. It is divided into the mountains of Velay (basaltic), Forez (granitic), and Madeleine (porphyritic), and runs off from the mountains of Vivarais, forming a high barrier between the Loire and the Allier. To the N. W. the granitic mountains of La Marche communicate with Mont Odouze. To the S., and detaching itself from the chain at Mont Lozère, stretches the vast region of the Causses, high calcareous plateaus deeply cut by the valleys of the Tarn, Lot, and Aveyron. These plateaus comprise nearly the whole of the old province of Rouergue. To the S., finally, are the mountains of Aubrac, a granitic group slightly connected with the mountains of Margeride.

Corsica is traversed from N. to S. by a chain of high mountains whose most elevated summit is Monte Cinto (8,888 feet).

2. *Hydrography.*—The flowing waters form in France seven principal basins—namely, those of the Seine, Loire, Garonne, Rhine, Maas, Scheldt, and Rhône. In the first three basins the water runs toward the N. W., to the English Channel and the Bay of Biscay; in the next three it runs northward to the North Sea, and in the basin of the Rhône it runs S.

France possesses more than 200 streams fit for navigation. Their length, as far as utilized, is 6,200 miles, of which 5,500 are used for navigation. The principal rivers in the *basin of the Seine* are the Seine, which waters Paris, Rouen, and Havre, where it forms a vast estuary, and its affluents—to the right, the Aube, Marne, and Oise, with its feeder the Aisne; and to the left, the Yonne and the Eure. Among the secondary basins belonging to that of the Seine are those of the Somme and the Orne. *In the basin of the Loire* flow the Loire, which passes by Nevers, Orleans, Blois, Tours, Nantes, and St.-Nazaire, and its affluents—from the right, the Maine: and from the left, the Allier, Cher, Indre, and Vienne. The Vilaine forms a secondary basin, and becomes navigable at Rennes. *In the basin of the Garonne* the Garonne, after its junction with its principal affluent, the Dordogne, forms the Gironde, on which stands Bordeaux. Its principal tributaries, the Tarn, Lot, and Dordogne, join it on the right. To this basin belong the Charente and the Adour, the latter passing by Tarbes and Bayonne. *In the basin of the Scheldt* are the Scheldt and its affluent, the Scarpe. *In the basin of the Maas*, the Maas, which in France is called the Meuse, receives at Namur, from the left, the Sambre. *In the basin of the Rhine*, the Rhine is navigable from Basel to the sea, and runs through Strassburg, Mainz, Coblentz, and Cologne. Its principal affluent, the Moselle, waters Metz, and receives the Meurthe, which passes through Nancy. *In the basin of the Rhône*, the Rhône traverses Lake Leman and waters Geneva and Lyons; receives from the right the Saône; and then proceeds toward the Mediterranean, where it forms its vast marshy delta. S. of Lyons its principal affluents are the Isère, Drôme, and Durance, which carry to it nearly all the water flowing into France from the Alps. To the same system belong the basins of the Var and the Aude.

The coast of the North Sea is low, partly marshy, and, down to the mouth of the Somme, bordered with a line of dunes, broken only by Cape Gris-Nez, which forms the nearest approach to England. Along the English Channel the coast of Normandy is bordered by cliffs which, cut and beaten in every direction by the sea, rise to the height of 820 feet, and extend to Cape de la Hève, W. of which the coast opens to the estuary and bay of the Seine. Then follows a line of low and dangerous rocks and the sandy and marshy estuary of Carentan, which touches the peninsula of Cotentin. This peninsula, flat in its southern part, rises to the N. between the points of Barfleur and La Hague, where its coast attains a height of 492 feet. In the angle formed by the peninsula and the northern coast of Finistère lies the bay of Mt. St. Michel, remarkable for the exceptional height of its tides (49 feet), and defended on the N. by the Channel Islands. The passage between these islands and the coast is very dangerous to navigate. The whole northern coast of Finistère is strewn with dangerous reefs extending to Point St. Mathieu, which forms the extremity of Brittany. At this point the coast suddenly retreats, and forms the vast roadstead at the head of which stands the naval port of Brest. From Brest to Lorient, also a naval port, the coast is lower, but still hilly. Along the coast from Finistère to the Charente are situated the islands of Ushant, Groix, Belle Île, Noirmoutiers, Yeu, Ré, and Oléron. From the Gironde to Spain the coast is traced as a straight line bordered by vast dunes, which are broken only to the right of the basin of Arcachon and at the mouth of the Adour.

Along the Mediterranean the western coast is low, and its gracefully rounded heads conceal a series of marshes, of which the most important are those of Than and Mauguio, but especially that of Berre, which separates Marseilles from the mouth of the Rhône. At Marseilles the coast rises, and thence to the Italian frontier presents a picturesque and much-indented line of headlands and bays.

The western coast of Corsica is steep and abrupt, the eastern low and marshy.

Climate.—The mean temperature is 12½° C., or 55° F. To the W. the isothermal lines are raised northward by the heating influence of the southwesterly winds and the Gulf Stream; to the E. they are lowered when removed from these influences. Rain is frequent and more abundant on the western coasts and in the mountainous regions (33 inches on the Atlantic coast; 23 inches in Paris; 39 inches in Morvan; 40 to 45 inches on the slopes of the Alps and Pyrenees). Although the climate is generally temperate and mild, it nevertheless presents five different types—the Sequanian (from the *Seine*), Vosgian, Rhodanian, Mediterranean, and Girondin. The Sequanian climate is N. of the Loire; its mean temperature is 52° F.—in winter 38° F., in summer 66° F. The prevailing winds are W., S. W., and S.; the first two are rain-bearing. The Vosgian climate is more extreme; its mean temperature is 49° F.; rain is less frequent. The mean temperature of the climate of the valley of the Rhône is 52° F., but the hot and dry southern winds, alternating with the cold northern, produce sudden changes in the temperature. Rain is abundant in the Alps. The Mediterranean climate is warmer, its mean temperature being 57° F. The summer is hot and dry; the autumn is rainy, and disagreeable on account of the cold and impetuous N. E. wind called the mistral. The climate in general is milder in the winter and hotter in summer than the Sequanian. N. W. and S. W. winds alternate, and produce rapid changes in the atmosphere.

III. AGRICULTURE.—France presents four agricultural belts which traverse it from S. W. to N. W.—namely, the olive, bounded by a line which connects the foot of the Corbières with the Alps of Dauphiné; the maize, whose northern boundary runs from the island of Oléron to the middle of the Vosges; the vine, which ceases at a line drawn from the mouth of the Loire to the source of the Oise; and N. of this line the apple-tree belt.

Fruits are largely exported—apples and pears from the north, oranges, lemons, and pomegranates from the south; excellent peaches, strawberries, and currants are grown near Paris; apricots in the central part; cherries near Paris and the coasts of the Channel. Dried fruits—pears, apples, prunes, figs, almonds, and nuts—come from the central and southern regions. The principal trees are the walnut, olive,


FRANCE
Scale of Eng. Miles
10 30 50 100
West Longitude East
ENGLISH CHANNEL
BAY OF BISCAY
NORTH SEA
STRAIT OF DOVER
CHANNEL ISLANDS
ENGLAND
LONDON
Greenwich
Maidstone
Canterbury
Dover
Reading
Bath
Bridgewater
Barnstaple
Bideford
Exeter
Dorchester
Southampton
Poole
Gosport
Chichester
Lewes
Hastings
Brighton
Portsmouth
Isle of Wight
PLYMOUTH
Dartmouth
Falmouth
Land End
Scilly Is.
Lundy I.
Alderney
Cherbourg
Guernsey
Jersey
Dunkirk
Calais
Boulogne
Abbeville
Dieppe
Le Havre
SEINE-INFÉRIEURE
Yvetot
ROUEN
BEAUVAIS
CAEN
CALVADOS
Bayeux
Lisieux
Honfleur
ST LO
NORMANDY
ORNE
ALENÇON
Argentan
EVREUX
EURE
PARIS
VERSAILLES
SEINE ET OISE
EURE ET LOIR
CHARTRES
Brest
Morlaix
ST BRIEUC
COTES DU NORD
FINISTERE
QUIMPER
BRETAGNE
MORBIHAN
VANNES
Lorient
Belle Isle
ILLE ET VILAINE
RENNES
Fougères
Dinan
St Malo
Avranches
MAYENNE
LAVAL
MAINE
SARTHE
LE MANS
La Flèche
Vendome
ORLEANNAIS
ORLEANS
LOIRE ET CHER
BLOIS
TOURS
TOURAINE
INDRE ET LOIRE
Loches
LOIRE INFÉRIEURE
NANTES
MAINE ET LOIRE
ANGERS
ANJOU
Saumur
Cholet
VENDÉE
NAPOLEON VENDÉE
LA ROCHE SUR YON
Sables d'Olonne
POITOU
DEUX SEVRES
NIORT
VIENNE
POITIERS
Fontenay le Comte
LA ROCHELLE
Rochefort
CHARENTE INFÉRIEURE
Saintes
Royan
GIRONDE
ANGOUMOIS
ANGOULEME
CHARENTE
Cognac
BERRY
INDRE
CHATEAUROUX
Issoudun
MARCHE
GUERET
CREUSE
LIMOGES
HAUTE VIENNE
CORREZE
TULLE
PERIGUEUX
DORDOGNE
BORDEAUX
GUIENNE
Bazas
LOT ET GARONNE
AGEN
Marmande
CAHORS
LOT
MONTAUBAN
TARN ET GARONNE
ALBY
TARN
AVEYRON
LANDES
MONT DE MARSAN
Dax
Bayonne
GASCONY
GERS
AUCH
TOULOUSE
HAUTE GARONNE
BEARN
BASSES PYRENEES
PAU
TARBES
HAUTES PYRENEES
COMTE DE FOIX
FOIX
ARIEGE
CARCASSONNE
AUDE
PYRENEES ORIENTALES
ROUSSILLON
PYRENEES
SPAIN
Puigcerda


Greenwich
HOLLAND
ANTWERP
BRUGES
GHENT
BRUSSELS
BELGIUM
MAESTRICHT
AIX LA CHAPELLE
LIEGE
NAMUR
MONS
Charleroi
Cambray
St Quentin
MEZIERES
AISNE
LAON
ARDENNES
Soissons
Reims
MARNE
CHALONS SUR MARNE
Sedan
LUXEMBURG
Luxemburg
Verdun
METZ
ALSACE
NANCY
STRASBOURG
TREVES
COBLENTZ
RHENISH PRUSSIA
COLOGNE
Deutz
Bonn
DUSSELDORF
Elberfeld
Crefeld
Venloo
Hasselt
Ehrenbreitstein
Bingen
WIESBADEN
MENTZ
Worms
MANNHEIM
Speyer
Kehl
BADEN
Freiburg
Breisach
Schaffhausen
CONSTANCE
Lake of Constance
Bregenz
Basel
Zurich
TYROL
Lucerne
BERN
SWITZERLAND
Lausanne
GENEVA
Chur
Lake of Como
Lecco
Bergamo
Como
Varese
Arona
Lugano
Magenta
LOMBARDY
MILAN
Lodi
Novara
Vercelli
Ivrea
ITALY
Pavia
Cremona
Piacenza
Parma
TURIN
PIEDMONT
ALESSANDRIA
Asti
Carmagnola
Savigliano
Pinerolo
Saluzzo
Coni
Mondovi
Savona
Voltri
GENOA
Chiavari
Spezia
GULF OF GENOA
Albenga
Ventimiglia
Mentone
NICE
Monaco
COMTE DE NICE
ALPES MARITIMES
Grasse
Antibes
Cannes
PROVENCE
DRAGUIGNAN
VAR
MARSEILLES
Toulon
Hyères
St Tropez
BOUCHES DU RHONE
Aix
Arles
Tarascon
AVIGNON
VAUCLUSE
COMTAT VENAISSIN
Carpentras
BASSES ALPES
DIGNE
Sisteron
HAUTES ALPES
GAP
Embrun
DAUPHINE
DROME
Montelimar
Nyons
Die
VALENCE
PRIVAS
ARDECHE
GRENOBLE
ISERE
Vienne
LYONS
LYONNAIS
RHONE
St ETIENNE
CHAMBERY
SAVOIE
Albertville
ANNECY
HAUTE SAVOIE
Chamouni
Mt Blanc
Martigny
BOURG EN BRESSE
AIN
MACON
LONS-LE-SAUNIER
JURA
FRANCHE COMTE
DOUBS
BESANCON
Pontarlier
Neuchatel
Salins
Dole
DIJON
COTE D'OR
Beaune
Autun
Chalon-sur-Saône
SAONE ET LOIRE
NIVERNAIS
NIEVRE
NEVERS
YONNE
AUXERRE
Avallon
TROYES
AUBE
CHAUMONT
HAUTE MARNE
Langres
VESOUL
HAUTE SAONE
BELFORT
EPINAL
VOSGES
LORRAINE
Lunéville
BAR-LE-DUC
St Dizier
Vitry le Français
Provins
Sens
Châtillon sur Seine
Montbard
Gray
BOURBONNAIS
Vichy
Thiers
Riom
CLERMONT FERRAND
PUY DE DOME
Montbrison
Issoire
Brioude
HAUTE LOIRE
LE PUY
LOZERE
MENDE
Alais
GARD
NIMES
Beaucaire
MONTPELLIER
HERAULT
Aigues Mortes
Cette
Narbonne
PERPIGNAN
Port Vendres
GULF OF LYONS
MEDITERRANEAN SEA
Tel. Cable
Part of CORSICA
Bastia
Calvi
Corte
I. Gorgona
I. Capraja
I. Giraglia
C. Corse
CORSICA
Scale same as main map
AJACCIO
Bonifacio
Strait of Bonifacio
I. Sardinia
Sartène
Porto Vecchio
Washington

chestnut, white oak, mulberry, oak, elm, ash, hornbeam, beech, alder, poplar, aspen, willow, birch, fir, larch, and pine.

Of the total land surface about 37,000,000 acres are under cereal crops, 21,000,000 in forests, more than 12,000,000 in meadow and grazing land, 5,730,000 in vineyards, and less than 17,000,000 are unproductive. The productive farm lands are valued at 91,500,000,000 francs ($18,300,000,000), and their annual products at 19,000,000,000 francs ($3,800,-000,000). According to *Bulletin No. 6*, 1891, of the Ministry of Agriculture, the areas and productions of the cereal crops were as follows: Wheat, 17,449,557 acres, 331,748,810 bush.; maize, 1,350,641 acres, 23,815,177 bush.; rye, 3,925,-510 acres, 68,583,274 bush.; barley, 2,168,369 acres, 48,683,-754 bush.; and oats, 9,342,176 acres, 265,690,158 bush. Other products were: potatoes, 3,619,415 acres, 405,639,026 bush.; tobacco, 38,172 acres, 49,052,350 lb.; and maslin, 733,768 acres, 13,523,675 bush. Since 1874 France has fallen from first to second wheat-producing country. The area in vineyards was largely reduced after 1875 on account of the ravages of the phylloxera, but in 1888 it showed an encouraging increase, and there has been a steady improvement since. The production of wine in 1888 was 662,247,000 gal. Of dairy products there were exported, according to the above *Bulletin*, 87,579,946 lb. of butter, valued at $21,188,-081; 15,082,460 lb. of margarine, value $1,188,344; and 12,232,137 lb. of cheese, value $1,682,962. The farm animals in 1891 comprised 2,883,460 horses, 13,661,533 cattle, 21,791,909 sheep; 6,096,232 swine, and 1,480,229 goats.

IV. INDUSTRY.—*Mining*.—Granite occurs in Cotentin, the Chausey islands, and several points of Brittany, in the Vendée, Limousin, the Alps, and the Vosges. Among volcanic products are the basalt of Auvergne and the porphyry of Corsica, Var, and Épinal. Excellent slate quarries are found in the vicinity of Angers. Bayonne gives feldspar and asphaltum from the clay-schist of Ain. The most remarkable marble quarries are at Boulogne, Maubeuge, and Givet in the north; at Le Mans and Sablé (Sarthe) in the west; at Chomerac (Ardèche), La Droix (Côte-d'Or), Châtillon (Loiret), and several other places in the central part of the country; at Campan, St.-Béat (white marble), Castéra-Verduzan (yellow marble), and Caunes in the Pyrenees, at Grenoble in the Alps, at Laveline in the Vosges, and at Corte in Corsica. Different kinds of freestone abound. Chalk is found at Rouen, Meudon (in the vicinity of Paris), Troyes, and in Touraine, etc. Of siliceous materials, excellent millstones are obtained from La Ferté-sous-Jouarre, and from Lesigny (Creuse), Bergerac (Dordogne), etc. The best plaster is that from the vicinity of Paris; the best cement comes from Boulogne, Vassy (Yonne), Pouilly (Côte-d'Or), and Grenoble. Calcium phosphate is found in the departments of Pas-de-Calais, Somme, Meuse, Vosges, Côte-d'Or, Gard, and Lot. Besides the common potter's clay, found everywhere, a finer sort is found at Gien and Limoges, from which a celebrated *faïence* is made. Porcelain clay is found at St.-Yrieix. Rock-salt is found near Nancy, and in the Jura, at Salins and at Lons-le-Saunier; sea-salt is produced from salt-marshes on the Atlantic from the mouth of the Loire to the Gironde, and on the Mediterranean coast.

Of mineral and thermal springs there are four groups: 1, the Vosges; 2, the Jura and the Alps; 3, the center; and 4, the Pyrenees. Besides these groups there are the sulphur springs of Enghien, near Paris, and of Bagnoles (Orne), the chalybeate springs of Forges-les-Eaux (Seine-Inférieure), and the famous springs of St.-Amand.

France is poor in metals, with the exception of iron. Argentiferous lead is found at Pontgibaud (Puy-de-Dôme), Vialas (Lozère), etc.; copper in the Alps and Corsica; zinc in small quantities in Gard and the Pyrenees; manganese at Romanèche (Saône-et-Loire); antimony in Haute-Loire, Cantal, and Corsica; nickel in small quantities in Isère (Les Chalanches); tin in Limousin and Bretagne; gold-dust in the sand of the Rhône; and iron pyrites for sulphuric acid in Gard, Ardèche, Rhône, and Vosges. In 1900 there were mined 33,270,385 tons of coal and in 1898 4,731,000 tons of iron ore. Anthracite is mined in Hautes-Alpes and Fréjus in Var; lignite in Aisne, Manosque, and Aix in Provence; and peat in the Pas-de-Calais, Somme, Aisne, Oise, Seine-et-Oise, Vosges, and Jura. Iron ore is found in the Jurassic regions—Le Creusot, Franche-Comté, Isère, Ardèche, Aveyron; and as bog ore in Ardennes, Champagne, Bourgogne, Franche-Comté, Berri, Poitou, Périgord, and Landes. The principal deposits are those of Vassy (Haute-Marne); Châtillonnais, which form a belt stretching through three departments; Franche-Comté, which are situated between Langres, Vesoul, Besançon, and Dijon; and the department of Cher, which are the richest in France and yield one-fifth of the whole production.

Manufacturing.—Agricultural machines are made in Paris, Liancourt (Oise), Nancy, Meaux, Orleans, and Bourges; spinning and weaving machines—for cotton, in Paris, Rouen, and St.-Quentin; for flax, in Lille; for wool, in Roubaix, Elbeuf, Louviers, and Sedan; for silk, in Lyons and St.-Chamond; for hosiery, in Nîmes; sewing-machines in Paris and Lyons; machine-tools in Paris, St.-Denis, Rouen, Le Creusot, etc.; tools for naval woodwork, in Havre; metallic wares in Paris, Villedieu (Manche), and Guise (Aisne); hardware for tools in Paris and St.-Étienne; for buildings, in Charleville (Ardennes), Laigle (Orne), Rugles (Eure); for the household, in Paris and Lille; and firearms at Paris, Châtellerault, St.-Étienne, Charleville, Tulle, etc. There are about 112 iron-foundries with 168 blast furnaces, and 200 iron-works with 1,000 furnaces. In 1900 the productions were 2,699,494 tons of pig iron, 745,-312 tons of finished iron, and 1,264,737 tons of steel.

Alcohol is made from wine at Hérault and in the Charentes, and from beet-root in Flanders; chemicals are manufactured in Paris, Lille, St.-Gobain, Chauny, Rouen, Cherbourg, Lyons, Montpellier, Marseilles, Bordeaux, etc.; oils are made from olives in Provence, Roussillon, and Southern Languedoc; from nuts, in Charente and Dordogne; from colza and flax-seed, in Flanders; from rape-seed, at Caen and in Franche-Comté. Candles and other chandlery products are made at Paris, Lyons, Montpellier, Marseilles, and Lille; soaps, at Marseilles, Nantes, Havre, Amiens, Rouen, Elbeuf, Reims, and Lyons; toilet soaps, at Paris; hair-dressing articles, at Givet, Paris, Château-Renault, and Grenoble; glue, in Flanders, Paris, and Givet.

Cheese-making is much developed. The most famous kinds are the Maroilles, Brie, Camembert, Neufchâtel, Livarot, Pont-l'Évêque, and Isigny; those of Jura resemble the gruyère of Switzerland; the Septmoncel and Mont d'Or cheeses are made of goat's milk; the well-known Roquefort cheese and the Cantal are made of sheep's milk. The manufacture of beet-root sugar is carried on especially in the northwest (Paris, Lille, Valenciennes, Douai, Arras, Péronne). In 1896 there were 356 sugar-works of all kinds, employing nearly 48,794 operatives. Liqueurs are distilled at Paris, Grande Chartreuse, and Cette. In the Vosges excellent cherry brandy (*Kirschwasser*) is made. Chocolate is manufactured in Paris, Noisiel, Bayonne, and the Nord. Vinegar is made in Charente and Orleans; mustard is prepared extensively in Paris, Bordeaux, and Dijon; drugs mainly in Paris.

The manufacture of cotton stuffs employs 5,000,000 spindles and nearly 70,000 looms, producing annually 600,000,000 francs' ($120,000,000) worth of fabrics. The manufacture of printed calicoes is confined to Paris and Rouen.

Of textile plants, hemp and flax are indigenous in France. The manufacture of linen employs more than 610,000 spindles, 178,000 power-looms, and 22,800 hand-looms, and has an annual product value of more than 500,000,000 francs ($100,000,000). This industry is principally located in the north.

Silks are manufactured principally in the valley of the Rhône. Besides the indigenous produce there is imported annually raw silk worth over 280,000,000 francs ($56,000,-000). The manufacture employs 94,800 looms and 110,300 hands, and the product is valued at 630,000,000 francs ($126,000,000).

V. TRADE AND COMMERCE.—The first railway was constructed in 1828 from Andrezieux to St.-Étienne and Lyons; horses were used until 1832, when the first locomotive was employed. The next was that from St.-Germain to Paris. The present railway system was begun in 1847; its actual length in 1898 was 23,324 miles. The railways cost $3,133,-509,360, and are worked by companies which have leases for ninety-nine years, when they become the property of the state. There are six great companies—namely, the West, the North, the East, the Paris Lyons and Mediterranean, the Orleans, and the South; and more than fifty small ones. The traffic on the railways amounted in 1898 to 385,873,000 passengers and 114,437,000 tons of merchandise. The receipts in 1898 amounted to $268,024,146, of which one-third was for passengers. The merchandise conveyed on the waterways is about three-tenths that of the railways.

Imports and Exports.—In 1899 the general commerce aggregated 5,848,000,000 francs ($1,128,664,000) in imports and

5,533,500,000 francs ($1,067,965,500) in exports, and the special commerce in 1900 4,408,500,000 francs ($850,840,500) in imports and 4,078,000,000 francs ($787,054,000) in exports.

The principal imports of raw material are silk, cotton, wool, flax, hemp, jute, hides, skins, sugar, coffee, tobacco, cocoa, spices, dyewood, etc.; also copper, lead, zinc, tin, iron, sulphur, coal, petroleum, building-timber, animals, etc. The importation of salt fish, butter and cheese, horses, fruit, rice, and other cereals reaches large proportions. That of manufactured articles comprises woven fabrics, flax and hemp, cotton, silk, hair, yarn, mattings and plaitwork, straw hats, machines and tools, and watches.

The exports consist chiefly of woven fabrics (silk, woolen, cotton, flax and hemp), yarn, linen, articles of toilet (furnishing goods, modes and perfumery), chemicals, madder and indigo, drugs, soap, stearin and candles, sugar, toys, haberdashery, etc., skins, tools, machines and arms, jewelry, watches, paper, pottery and glassware, and musical instruments. Of other products are exported wine and brandy, textile fibers (silk, cotton, wool, and hair), cereals, cheese and butter, eggs, dried vegetables, fruit, olive oil, salt-water fish, salted meat, horses and cattle, seed corn, hides, oleaginous seeds, wood, and copper.

The merchant marine is not prosperous. The number of vessels has remained stationary for about thirty years, though the tonnage has doubled. On Jan. 1, 1900, there were 14,262 sailing vessels of 450,636 tons and 1,227 steam vessels of 507,120 tons, with crews aggregating 81,732. During 1899 the number of vessels of all kinds that entered French ports was 101,370, of 24,911,506 tons.

The post and telegraph services are regulated by the state. On Jan. 1, 1899, there were 9,776 post-offices in France and Algeria, which handled 2,462,295,000 articles of all kinds. The telegraph service in 1899 had 79,396 miles of lines, 400.341 miles of wire, and 12,328 offices, and handled 43,963,811 messages. The receipts of the joint services 1898–99 were 250,442,320 francs ($48,335,368) and expenditures 184,721,465 francs ($35,551,243).

Measures, Weights, and Money.—The system of weights and measures used in France and its dependencies is the METRIC SYSTEM (*q. v.*).

The money basis is the FRANC (*q. v.*). Besides the various coins and the ordinary commercial paper, used principally in the great financial and banking establishments, France employs bills on the Banque de France, whose credit is equal to that of the state. The coinage in 1900 amounted to 36,619,537 francs, of which 30,048,830 francs was gold. From 1795 till 1899 the total coinage of gold was 9,565,473,070 francs, and of silver 5,613,719,125 francs. It was estimated that 14,731,803,108 francs in coin were in circulation, of which two-thirds were gold. See FRANCE in the Appendix.

VI. POPULATION.—The population by census of 1891 was 38,343,192, an increase of 671,144 from 1881. The census of 1896 showed the legal population (that is, both present and absent), to be 38,517,975, including 1,027,491 foreigners. Vital statistics for 1894 showed 286,662 marriages, 855,388 births, and 815,620 deaths. The majority of the population (24,500,000) is settled in the country; about 18,500,000 live by agriculture. There are about 4,000,000 in business. Building and the manufacture of textile fabrics, clothing, and toilet articles employ about 1,000,000 persons each. The ten departments which owe their prosperity especially to manufactures or commerce are Seine, Bouches-du-Rhône, Rhône, Loire, Nord, Loire-Inférieure, Gironde, Var, Vendée, and Corsica. In 1896 the population of the principal cities was as follows:

Paris	2,536,834	Tourcoing	73,353
Lyons	466,028	Rennes	69,937
Marseilles	442,239	Dijon	67,736
Bordeaux	256,906	Orleans	66,619
Lille	216,276	Grenoble	64,002
Toulouse	149,963	Tours	63.267
St.-Étienne	136,030	Le Mans	60,075
Roubaix	124,661	Besançon	57,556
Nantes	123,902	Calais	56,940
Havre	119.470	Versailles	54,874
Rouen	113,219	St.-Denis	54.432
Reims	107,963	Troyes	52.998
Nancy	96,306	Clermont-Ferrand	50,870
Toulon	95,276	St.-Quentin	48.868
Nice	93,760	Béziers	48,012
Amiens	88,731	Levallois-Perret	47,315
Limoges	77,703	Boulogne	46,807
Angers	77,164	Caen	45,380
Nîmes	74,601	Avignon	45,107
Brest	74,538	Bourges	43,587
Montpellier	73,931	Lorient	41,894

VII. GOVERNMENT.—Since the revolution of Sept. 4, 1870, France has been ruled by a republican government, and by the law of Feb. 25, 1875, the National Assembly decided on the definitive form of government and constitution. The executive, administrative, and judiciary powers are vested in the President. The legislative power is exercised by the National Assembly. The President is elected by the National Assembly for a period of seven years. He exercises the executive power, chooses and dismisses the ministers, who are responsible, however, not only to him, but also to the National Assembly, which consists of the Chamber of Deputies (584 members) and the senate (300 members; 75 were elected for life under the law of 1875). Each arrondissement elects one deputy, and if it has more than 100,000 population, two. Senators are elected for nine years, one-third retiring every three years. Vacancies occurring among life senators are filled by the election of ordinary nine-year senators. The National Assembly holds annual sessions of at least five months. Senators receive 15,000 ($3,000) and deputies 9,000 ($1,800) francs per annum. The National Assembly represents the nation, by which it is elected and in whose name it exercises the sovereign power. With the consent of the senate the President can dissolve the Chamber of Deputies. The ministers, of whom the one chosen by the chief magistrate as chief of the cabinet is president of the council, are ten—1, Minister of Justice and of Religion; 2, Minister of the Interior, under whom are the whole general departmental and communal administrations of France; 3, Minister of Foreign Affairs; 4, Minister of Finance and of Posts and Telegraphs; 5, Minister of War; 6, Minister of Marine and the Colonies; 7, Minister of Public Instruction and the Fine Arts; 8, Minister of Agriculture; 9, Minister of Commerce and Industry; 10, Minister of Public Works.

Communal and Departmental Administrations.—The commune represents the elementary unit of the territorial division and of the administrative organization. It is a part of the territory comprising either a town or one or more villages, with their annexes and fields. It is governed by a *maire*, *adjoints* (deputies), and a municipal council. The mayor is appointed by the municipal council from its own number. He is assisted by one or more deputies, who are appointed in the same manner, and who take his place in case of absence. The municipal council, of which the mayor is the president, and which is composed of from 10 to 36 members elected by the inhabitants of the commune, exercise within the very narrow limits of the law a deliberative power in all communal affairs, issuing either decisions or deliberations or simple advice. It holds annually four sessions, generally of ten days each. Paris has a special administration; its municipal council of 80 members elects its president and vice-president.

The canton generally consists of twelve communes. It is not, properly speaking, an administrative division, but it serves as a basis for the election to the general council and to the council of the arrondissement. It is specially a judiciary circumscription. Recruiting for the army takes place at the principal town of the canton.

The arrondissement consists, generally, of eight cantons. It is governed by an under-prefect, who ranks next to the prefect of the department. The arrondissement, however, in which the capital of the department is situated is governed by the prefect himself. The under-prefect is appointed by the chief of the state. He is assisted by a council of the arrondissement, which consists of as many members as there are cantons. It assembles on the call of the prefect, deliberates on public works, and assesses the direct contributions upon the commune.

The department consists generally of four arrondissements, and is the only division of any great consequence in an administrative point of view. The prefect, who governs it, is appointed by the President of the republic on the nomination of the Minister of the Interior. He represents the Government, brings the laws and the ministerial orders into execution, superintends and maintains public order, and exercises a sort of police inspection over the towns. He introduces all affairs concerning the department, and executes the decisions of the general council and of the departmental committee within the limits of the law. The deliberative power pertains to the general council, composed of as many members as there are cantons, though not more than thirty, who are elected for nine years and renewed by thirds. It deliberates and votes on all departmental affairs; in the interval between its sessions it assigns its power to a departmental committee, which superintends the administration of the commune. Besides these two powers there is a third administrative power, exercised by the council of the prefecture, which decides on all demands for reductions in contributions, etc. Relief to the poor and the sick must be provided for by the commune; the communal hospitals are governed by a committee of five members, appointed by the prefect and presided over by the mayor. The arrondissements have generally hygienic committees, physicians for the poor, committees for inspecting drug-shops, etc. Every department must have an asylum for lunatics.

VIII. Constitution and Administration. *Administrative Divisions.*—In 1891 there were 36 old provinces, forming 87 departments, 362 arrondissements, 2,881 cantons, and 36,144 communes. In the early part of 1893 13 new cantons were formed in the department of the Seine. The following table shows the provinces, the departments, and the capitals of the latter:

1. Northwest.

Provinces.	Departments.	Capitals.
Flanders	Nord	Lille.
Artois	Pas-de-Calais	Arras.
Picardy	Somme	Amiens.
Normandy	Seine-Inférieure	Rouen.
	Eure	Evreux.
	Calvados	Caen.
	Orne	Alençon.
	Manche	St.-Lô.
Brittany	Ille-et-Vilaine	Rennes.
	Côtes-du-Nord	St.-Brieuc.
	Finistère	Quimper.
	Morbihan	Vannes.
	Loire-Inférieure	Nantes.
Anjou	Maine-et-Loire	Angers.
Maine	Mayenne	Laval.
	Sarthe	Le Mans.
Île de France	Seine-et-Oise	Versailles.
	Seine	Paris.
	Seine-et-Marne	Melun.
	Oise	Beauvais.
	Aisne	Laon.

2. Northeast.

Champagne	Ardennes	Mézières.
	Marne	Châlons.
	Aube	Troyes.
	Haute-Marne	Chaumont.
Lorraine	Meuse	Bar-le-Duc.
	Meurthe-et-Moselle	Nancy.
	Vosges	Épinal.
Alsace	Belfort	Belfort.
Franche-Comté	Haute-Saône	Vesoul.
	Doubs	Besançon.
	Jura	Lons-le-Saunier.
Burgundy	Ain	Bourg.
	Saône-et-Loire	Mâcon.
	Côte-d'Or	Dijon.
	Yonne	Auxerre.

3. Southeast.

Lyonnais	Loire	St.-Étienne.
	Rhône	Lyons.
Dauphiné	Isère	Grenoble.
	Drôme	Valence.
	Hautes-Alpes	Gap.
Savoy	Savoie	Chambéry.
	Haute-Savoie	Annecy.
Comtat Venaissin	Vaucluse	Avignon.
Provence	Bouches-du-Rhône	Marseilles.
	Var	Draguignan.
	Basses-Alpes	Digne.
Nice	Alpes Maritimes	Nice.
Corsica	Corsica	Ajaccio.
Languedoc	Haute-Loire	Le Puy.
	Ardèche	Privas.
	Lozère	Mende.
	Hérault	Montpellier.
	Aude	Carcassonne.
	Tarn	Albi.
	Haute-Garonne	Toulouse.
	Gard	Nîmes.
Roussillon	Pyrénées-Orientales	Perpignan.
Foix	Ariège	Foix.

4. Southwest.

Guyenne and	Hautes-Pyrénées	Tarbes.
Gascony	Gers	Auch.
	Tarn-et-Garonne	Montauban.
	Aveyron	Rodez.
	Lot	Cahors.
	Dordogne	Périgueux.
	Lot-et-Garonne	Agen.
	Gironde	Bordeaux.
	Landes	Mont-de-Marsan.
Béarn	Basses-Pyrénées	Pau.
Angoumois	Charente	Angoulême.
Aunis and Saintonge	Charente-Inférieure	La Rochelle.
Poitou	Vendée	La Roche-sur-Yon.
	Deux Sèvres	Niort.
	Vienne	Poitiers.

5. Center.

Touraine	Indre-et-Loire	Tours.
Orléanais	Loire-et-Cher	Blois.
	Eure-et-Loir	Chartres.

Center (continued).

	Loiret	Orleans.
Berri	Cher	Bourges.
	Indre	Châteauroux.
Marche	Creuse	Guéret.
Limousin	Haute-Vienne	Limoges.
	Corrèze	Tulle.
Auvergne	Cantal	Aurillac.
	Puy-de-Dôme	Clermont-Ferrand.
Bourbonnais	Allier	Moulins.
Nivernais	Nièvre	Nevers.

Army.—The army consists of volunteers or re-enlisted men, who form about one-tenth of the annual contingent, and young men twenty years of age and fit for military service, whom the recruiting laws summon annually to form what is called "the contingent." These young men serve three years in the active army, ten years in the reserve of the active army, then six years in the territorial army, and at last six years in the reserve of the territorial army. All privileges of exemption were abolished in 1887. According to the budget for 1901 the strength of the army on a peace footing was 29,990 officers and 568,775 men, total 598,765, with 143,667 horses, and the war effective was estimated at 2,500,000 officers and men.

Navy.—Exclusive of transports, sailing vessels, school-ships, etc., the French fleet consists (1901) of 299 vessels, of which 26 are battle-ships, 18 port-defense vessels, 68 cruisers of different classes, and 187 torpedo-craft, besides 27 vessels of different kinds in course of construction. The *personnel* consists of 1,733 executive officers (including 15 vice-admirals and 30 rear-admirals), 225 principal engineer officers, and 40,589 men, recruited either by voluntary enlistments or from a portion of the army contingent, or by drafting those men from the seaboard whose names are entered on the naval registers. The total number enrolled is 150,000. The maritime territory is divided into five arrondissements, commanded by a maritime prefect, who has the rank of vice-admiral. Their capitals are Cherbourg, Brest, Lorient, Rochefort, and Toulon. The naval expenditure of France, which in 1880 was 186,000,000 francs, was increased in 1899 to 304,078,400 francs. See Naval Academies and Ships of War.

Finances.—The budget of the commune is prepared by the mayor, voted by the municipal council, and approved by the prefect or by the chief of the staff if the revenue exceeds 3,000,000 francs ($600,000). The departmental budget is prepared by the prefect, submitted to the departmental commission, and discussed and voted by the general council. The budget of the state is prepared by the ministers, presented by the President of the republic, and discussed by the National Assembly one year in advance. The expenses of the state for 1901 are estimated as follows:

	Francs.
Finance (public debt and dotations)	1,278,105,141
Justice and worship	78,417,486
Foreign affairs	16,554,210
Interior	79,567,158
War	693,614,531
Marine and colonies	432,804,299
Public instruction and fine arts	221,351,398
Commerce and industry	36,660,891
Agriculture	44,908,845
Public works	669,298,419
Total	3,551,292,378

The receipts of the general budget come from the following sources:

	Francs.
Direct taxes	522,596,614
Indirect taxes and revenues	2,117,391,250
Proceeds from the public domain	52,710,300
Proceeds of monopolies and industrial enterprises of the state	728,651,830
Sundry receipts of the budget	69,596,418
Recettes d'ordre	60,624,085
Total	3,551,570,497

The following are some details of the different receipts: In the direct taxes the land tax amounts to 196,700,000 francs ($39,340,000); personal tax, 88,200,000 ($17,640,000); tax on doors and windows, 57,200,000 ($11,440,000); tax on patents, 122,600,000 ($24,520,000). Of indirect taxes the most important are:

	Francs.
Registration	553,112,000
Stamps	181,532,400
Customs	453,049,800
Indirect contributions (beverages, salt, etc.)	649,022,550
Sugar	199,500,000
Tobacco	413,261,000
Post-office and telegraph	255,028,400

On Jan. 1, 1900, the public debt amounted to 30,055,398,-100 francs ($5,800,691,833).

Justice.—Justice is administered in the name of the chief of the state. There are three different jurisdictions: (1) The civil jurisdiction, which takes cognizance of all personal or real relations of the citizens. It is exercised by justices of the peace, of whom there is one in each canton, who conciliates, if possible, or decides cases of minor importance. Above them are the civil tribunals, or tribunals of first instance, which pronounce annually on about 140,000 cases. There are 138 *conseils de prudhommes*, of whose members half are elected by the employers and half by the employees, and who in the manufacturing towns act as justices of the peace in cases between employer and employed; they consider annually 40,000 cases, of which more than two-thirds are conciliated. In the manufacturing and commercial cities there are 222 tribunals of commerce, whose members are elected, and which pronounce in first instance on about 250,000 cases annually, of which one-fourth are conciliated and two-thirds closed by definitive judgment. Above the civil tribunals and the tribunals of commerce there are twenty-six courts of appeal, which judge about 12,000 cases annually. (2) The criminal jurisdiction. The simple misdemeanors come before the tribunals of police. The justices of peace exercise this jurisdiction in 385,000 cases annually. Offenses are brought before the tribunals of correction, which form a particular branch of the civil tribunals, and which can administer from six days' to five years' imprisonment. Grave crimes are brought before the courts of assize (3,100 to 3,700 cases a year), of which there is one in each department. They are composed of three magistrate-judges and a jury. The jury is composed of twelve citizens, who must be over thirty years old, and are selected by a special committee in each canton, and subject to approval and rejection by a district committee. The jury decides the point of fact, the judges apply the law. Besides the magistrature which judges there is a magistrature which performs the duty of public prosecution. To each court of appeal a general procurator is attached, assisted by several advocates or deputies. To each civil tribunal, and under the authority of the general procurator, is attached a procurator of the republic, assisted by one or several substitutes. At the police tribunals the office of public prosecutor is performed by the mayor or the commissioner of police. The public prosecutor interferes only exceptionally in civil cases. In criminal cases, on the contrary, he acts a principal part. He orders the investigation of the offense or crime, has the accused person arrested, superintends the trial, prosecutes before the judges, and proceeds with the execution of the verdict given. Above all the other tribunals is the court of cassation, which secures the exact application of the law, and any verdict given by any tribunal may be brought before it. By its decrees it confirms or reverses the verdict given, and in case of cassation the suit is recommenced before another tribunal instituted by the court of cassation. The convicts receive their punishment, according to the gravity of their offense, in the police prisons, in the departmental prisons, which also serve as jails (381 jails, with room for 25,000 inmates), in the penitentiary colonies for young convicts, in the central prisons for those sentenced to compulsory labor, in the houses of detention for local crimes, and in the penal colonies of Guiana and New Caledonia. With the administration of justice are furthermore connected the notaries, who receive acts and contracts and give them the character of authority; the attorneys, who represent the parties before the tribunal; and the sheriffs, who carry the summons, serve the judgment, and regulate its execution.

Public Education.—The school system was founded by the National Convention in 1792, and is administered by the commune and the department under the general control of the Minister of Public Instruction and Fine Arts, and a national council. Primary instruction is gratuitous and obligatory; it is given in the communal schools, which are under the direction of lay teachers appointed by the prefects. Each commune of 500 inhabitants is obliged to have a school for boys and one for girls. There were more than 5,600,000 pupils distributed in 67,359 public schools and 14,498 free schools in 1890; and besides these there are about 9,053 educational institutions of a higher grade, *cours d'adultes*, and a number of infant schools which prepare children under seven years of age for the primary schools. The teachers are educated in 90 primary normal schools for males, with 5,445 master pupils, and 82 normal schools for females, with 3,564 pupils, about one for each department. There are, besides, two higher normal schools, one for each sex. The secondary, classical, or industrial instruction is given by the state in the lyceums, by the communes in the communal colleges, and by the clergy or by laymen in the seminaries. There were in 1891 107 lyceums, which were generally situated in the capitals of the departments, and contained more than 51,000 pupils; 246 colleges, with 34,000 pupils; and 650 free establishments, with nearly 68,000 pupils. For girls there were 24 lyceums, with 4,000 pupils, and 27 colleges, with 3,000 pupils. The classical schools give diplomas of *bachelier de l'enseignement secondaire classique* and *bachelier de l'enseignement moderne*, the latter course substituting the study of modern for that of the dead languages. In order to educate professors the state has established for the classical branch the high normal school, and for the industrial branch the special normal school at Cluny. (See Common Schools.) The higher instruction is given by the universities (*facultés*), of which there are 15 for literature and science, 12 for law, 7 for theology, and 4 for medicine. The universities confer diplomas of *bachelier*, *licencié*, and *docteur*. The Collège de France and the Museum of Natural History, both in Paris, represent the independent studies; the Conservatoire des Arts and Métiers (for arts and trades), in Paris, is a sort of industrial university.

The principal schools preparatory for the civil service are: (1) in Paris, l'École Polytechnique, for officers and state engineers; the Central School of Arts and Manufactures, for civil engineers; the School of Fine Arts, for painters, sculptors, and architects; the Conservatory of Music and Declamation, for musicians and actors; the school for living Oriental languages. (2) Outside of Paris there are three schools of the arts and trades, several schools of fine arts (Dijon, Toulouse, etc.), 3 schools of agriculture, 1 of horticulture, 3 for veterinary surgeons, 1 for miners at St.-Étienne, and 1 for mining engineering; to which may be added several communal and private institutions, such as schools for drawing, Central School in Lyons, the school for watchmaking in Besançon, etc. (3) In foreign countries the French school in Rome for a limited number of artists, painters, sculptors, architects, and musicians, chosen by competition; and the schools of Rome and Athens for the study of ancient literature, to which the pupils are chosen from among the pupils of the high normal school. The administration of each of the sixteen academies, or territorial circumscriptions of public instruction, is confided to a rector assisted by an academical council. The rector has under his orders an inspector of the academy and several inspectors of the primary instruction. Algeria has a separate academy. The instruction is facilitated by libraries, which exist in most of the towns, and which are being founded in the communes, in the primary schools, in the regimental schools, and at the museums. There are learned societies in most all the departments, and some of them have a high reputation. In Paris there are, among others, the Association Française pour l'Avancement des Sciences, Société de Géographie, de Géologie, d'Anthropologie, Association Polytechnique, Société d'Agriculture, etc., besides several great public institutions, such as the Observatory, the Bureau des Longitudes, the Medical Academy, and l'Institut de France, composed of five académies (Académie Française, des Inscriptions et Belles-Lettres, des Sciences, des Beaux-Arts, des Sciences Morales et Politiques), each of which contains 40 members (Académie des Sciences 66) chosen by the members themselves.

The military schools are l'École spéciale militaire, of St.-Cyr, for the infantry and the cavalry; l'École d'application de l'artillerie et du génie, at Fontainebleau; l'École d'application de cavalerie, at Saumur, for officers and for under-officers proposed for the rank of officers; l'École de médicine et pharmacie militaire, at Val-de-Grâce, at Paris; l'École d'application des poudres et saltpêtres; l'École militaire d'infantrie, of St.-Maixent, and l'École militaire d'artillerie et du génie, at Versailles, both intended for under-officers proposed, on examination, for the rank of officers. There are also numerous technical schools, such as l'École d'administration, at Vincennes; l'École normale de gymnastique, l'Écoles regionales de tir, l'Écoles régimentaires de l'artillerie et du génie, etc.; above all these schools, l'École supérieure de guerre, at Paris, which trains officers, captains, sub-lieutenants, for the brevet d'état-major. Le Prytanée militaire de la Flèche, a kind of military lyceum, receives the sons of indigent officers and of sub-officers killed in battle. The marine receives most of its officers from the naval school at Brest. There are also 19 écoles d'hydrographie, and 3 écoles de médecine navale at Toulon, Brest, and Rochefort; l'École du génie maritime (for naval construction) in Paris; l'École de torpilles of Toulon, l'École des mousses and l'École de maistrance of Brest, etc. La Maison d'Éducation of the Legion of Honor at St.-Denis receives without charge the daughters of officers and sub-officers of the Legion of Honor.

WORSHIP.—There are in France three forms of *worship* recognized by the state and maintained at its expense—the Roman Catholic, the Protestant, and the Jewish; and in Algeria, in addition, the Mussulman. Any sect in France with 100,000 adherents is entitled to an annual state grant.

The Roman Catholic Church.—The parish is the elementary unit, and there is a parish or more in each commune. Of the parishes, some are *curacies*, others *succursals*. The former number 45,000; the priest is irremovable, appointed by the bishop, and approved by the state. The priests of the latter parishes are appointed by the bishop, and may be removed by him. Above the priest is placed the bishop. According to the concordat of 1801 there are 84 dioceses, 67 bishoprics, and 17 archbishoprics in France, nearly one in each department; the see of the bishop is generally at the capital of the department. In 1890 the secular clergy numbered 50,420, besides 4,376 teachers and 9,526 students in seminaries. Above the bishops stand the archbishops, who administer their own dioceses and exercise authority over ecclesiastical provinces or archbishoprics consisting of several dioceses or bishoprics. There are 17 archbishoprics, corresponding nearly to the old provinces from the Roman period—namely, Paris, Rouen, Tours, Cambray, Rennes, Reims, Besançon, Lyons, Chambéry, Avignon, Aix, Toulouse, Bordeaux, Auch, Alby, Bourges, and Sens. Above the archbishops are five cardinals. The budget grant for 1897 for this Church was 41,266,023 francs ($8,253,204).

The Protestant Church.—This comprises two denominations recognized by the state—the Calvinistic and the Lutheran. In both of them the parish has its minister and presbyterial council, which administer under the authority of the consistory. In the Calvinistic Church the ministers are chosen by the consistory, and the superior authority is exercised by the synod, consisting of five consistorial churches, and by the central council of the Reformed Church. At Montauban is a theological university. In the Lutheran Church the ministers are chosen by a directory which acts under the authority of the consistory. The grant for this Church was 1,495,100 francs ($299,020).

The Jewish Church.—A communal rabbi presides at each synagogue, assisted by officials who are under the authority of a departmental consistory, which again ranks under the central consistory of Paris, presided over by the grand rabbi. The grant for this Church was 206,530 francs ($41,306).

Algeria forms one archbishopric (Algiers) and two bishoprics (Oran and Constantine). It has two Protestant consistorial churches and three Jewish consistories. The grant for Algeria in 1893 was 1,238,596 francs ($247,719).

F. PRUDENT. Revised by R. LILLEY.

France, History of: begins in the fifth century with the conquest of the Roman province of Gallia Transalpina by the Franks, a Gotho-Germanic tribe who settled in the country and gave it its name. Ancient Gaul (Gallia Transalpina) was originally inhabited by three different nations —the Belgians, in the north and east; the Celts, in the west and center; and the Aquitanians, in the south. Along the Mediterranean coast several Greek colonies were situated, the chief of which was Massilia. These nations, subdivided into many different tribes, the Batavi, Helvetii, Ædui, *et al.*, were subdued by Cæsar between 58 and 52 B. C., and the whole country reduced to a province of the Roman empire. Roman institutions, language, civilization, and religion gradually took root among the people, and the country flourished; but in the fifth century A. D. the Roman empire had become too much expanded to defend its frontier at all points. Representatives of the Teutonic tribes had gradually entered Roman territory and worked themselves into various industrial vocations. Even the Roman army came largely to be made up of German recruits and allies. When the general movement of the barbaric tribes from the north and east took place, the Romans were in no condition to withstand the attacks along the frontier. The army in Britain was recalled, but even the re-enforcement thus afforded was not sufficient to prevent the barbarians from overrunning Gaul. The Visigoths settled in the southern part, and connected it with Northern Spain; the Burgundians established an independent kingdom in the east; and in 486 Khlodwig or Clovis, chief of the Salian Franks, a grandson of Merovæus and founder of the *Merovingian* dynasty, defeated the Roman governor at Soissons, and took possession of the whole northern part of the country to the Loire. In 507 he also defeated the Visigoths at Vouillie, and added their possessions N. of the Pyrenees to his dominions, thus forming a kingdom which comprised nearly the same area as modern France, with the exception of the eastern districts between the Rhine, the Saône, and the Rhône, which were occupied by the Burgundians. He embraced Christianity 496, and by this step succeeded in reconciling the clergy, and, through them, the Gallo-Romanic population, to his rule; so that at his death in 511 a Frankish empire was actually consolidated in Gaul. (See FRANKS.) The further development of this new kingdom was seriously impeded, however, by civil wars between the eastern Franks (Austrasia) and the western (Neustria), brought on by the dangerous custom, common to all Gotho-Germanic nations, of dividing the kingdom at the death of the king between his sons. But fortunately, during the last kings of the Merovingian dynasty, who were men of weak characters and with no talents as rulers, a new family rose into power, capable of keeping the empire united in spite of the tendencies to separation which it contained, and capable of defending it against the most formidable enemies from without. Pepin of Héristal, *major domus* to Clovis II., established the authority of Austrasia firmly in the dominions of Neustria, and his son Charles Martel, succeeding him in his position as *major domus*, a sort of viceroyship, routed the Saracens at Tours in 732. Charles Martel's son, Pepin the Short, confined, with the consent of the clergy and the pope, the last king of the Merovingian dynasty, Childeric III., in a monastery, and ascended the throne himself in 752, thus founding the *Carlovingian* dynasty. The Merovingian kings had established a Gotho-Germanic empire on Roman soil; during the reign of the Carlovingian dynasty this Gotho-Germanic empire became French. The formation of a new kingdom was followed by the formation of a new nation. Pepin the Short ruled with great vigor, and made one very valuable addition to his dominions—namely the coast regions along the Mediterranean, which hitherto the Arabs had held. His son, Carl or CHARLES THE GREAT (*q. v.*), defeated his enemies with masterly ability and consolidated the government, from 768 to 814. Although at this time the different tribes of the Gotho-Germanic race had formed several nationalities, and in several places commenced the development of individual forms of civilization, still the settlement was not yet final. By transforming the chiefs of the tribes into feudal lords, vassals with power, but also with responsibility, and by introducing Christianity and the institutions of the Roman Catholic Church throughout his realm, Charles secured the first rudiments of order.

The name "France" occurs for the first time in history in the middle of the ninth century. After the death of Louis le Débonnaire, a son of Charles, the empire was divided between his three sons by the treaty of Verdun in 843. Louis the German received that part which lay E. of the Rhine, and which was called Deutschland (Germany); Charles the Bald received that part which lay W. of the Scheldt, Meuse, Saône, and Rhône, and which was called France; the long strip of land stretching between these two boundary-lines from the North Sea to the Mediterranean was given to Lothair, together with Italy and the title of emperor. As soon as the treaty was concluded wars broke out between the contracting parties, and these wars did not cease until a new dynasty, which had grown up on French soil, and which entertained no general Gotho-Germanic (but simply French) ambition, ascended the throne of France. It was, however, not so much their imperial ambition as their utter inability which cost the Carlovingian kings their crowns. There were forty hereditary (i. e. independent) vassals in the territory of France. One of them was the Duke of Normandy, formerly the chief of the Norse pirates, to whom Charles the Simple had given in 912 the beautiful province W. of the Lower Seine, in order to stop the invasions. Another was the Count of Paris, one of whose family, Count Odo, was chosen king in 887, and vindicated himself till his death, in 898, against Charles the Simple. A third was the Duke of Lorraine, who offered his allegiance to the King of France or to the Emperor of Germany, just as he liked. To a man who had no other purpose than to govern these forty vassals the task might prove difficult enough, and it became fatal to any one who besides had Gotho-Germanic ambitions. When, at the death of Louis V. in 987, the vassals passed by the proper heir, Charles of Lorraine, because he had given his allegiance to the German emperor, and chose for king Hugh Capet, Count of Paris, Duke of France, and founder of the *Capetian* dynasty, there was a French nation, but there was hardly a French kingdom in existence.

The consolidation of the royal power and the establishment of the feudal monarchy are the leading ideas in the history of France under the two following dynasties—the house of *Capet*, from 987 to 1328, and its collateral branch, the house of *Valois*, from 1328 to 1589. Not that they are the sole motives in all the various events which crowd its pages during this period, but they are the common result of them all. The crusades acted chiefly as a vent for the romantic ambition of the feudal lords, and as a means of rallying them around the person of the king. The Church was usually an ally of the crown, and for the time from 1309 to 1377, while the pope resided at Avignon and two œcumenical councils were held here in 1326 and 1377, even a very submissive ally. The Reformation was actually used as a means of curbing and destroying the heads of the nobility, and the very moment it became a party against the absolute power of the king it was crushed. The wars with England and Austria were thoroughly dynastical, and could not help attaching a particular importance to the representative of the dynasty. The development of the cities was furthered and privileges were granted to the burghers, so far as to enable the third estate to form an effective opposition to the nobility, but not so far as to make it capable of checking the royal power. And even the nobility itself was made a monarchical instrument. It lost its power, but not its splendor. It was transformed from a feudal aristocracy into a court nobility. And it is this transition from the feudal to the absolute monarchy, together with the consequences following therefrom, which gives the history of France its paramount importance in the history of Europe. How early a powerful national feeling was developed in France was shown under Louis VI. (1108–37). In the long wars which he waged against Henry I. of England about Normandy, which by the Norman conquest of England threatened to become lost to the French crown, Henry succeeded in establishing a formidable alliance with the German emperor. But, although the relations between the French king and the French vassals—the Counts of Flanders, Champagne, Lyons, Provence, Toulouse, etc.—were very loose, in this emergency an army of 200,000 men was immediately formed for the defense of France. Louis VI. was a sagacious ruler. He abolished serfdom in his own territories, and formed his cities with their adjacent districts into corporations. But by his example he compelled his neighbors to do the same, and thus he sowed a very fertile seed of opposition to the feudal lords among their own subjects. Philip Augustus (1180–1223) took the first steps toward centralization, and took them successfully. He formed a chamber of peers, a sort of council of state, consisting of six secular and six ecclesiastical members, which tended to secure uniformity in the actions of the king and his vassals; and he established the right of appeal from the decision of the feudal lord to the royal court; which measure, in the course of time, seriously impaired the influence of the lord. Meanwhile the crown grew richer. Philip Augustus conquered Normandy, Maine, Touraine, and Poitou from the English after the battle of Bouvines in 1214; Philip III. (1270–85) acquired Toulouse and Venaissin by negotiation; and Philip IV. (1285–1314) received Navarre, Champagne, and Brie by marriage. This latter prince could afford to treat the order of the Templars in the most arbitrary and despotic manner, and on one occasion, when the nobles pressed him too hard, he baffled all their exertions by convoking for the first time (Mar. 28, 1302) that important assembly which came to be known in French history as the *States General*, which was made up of representatives of the three estates: the first the clergy, the second the nobility, and the third the free cities. On the accession to the French throne of the house of Valois, in 1328, with Philip VI., nephew of Philip IV., the terrible wars with England began, the English king, Edward III., claiming the crown of France as a grandson of Philip IV. These wars are known as "the Hundred Years' war." But when at last the Maid of Orleans succeeded in rousing the national feeling to an unconquerable pitch, and carried, in 1429, Charles VII. to Reims to be crowned, all the enthusiasm of the people was concentrated on the person of the king. In spite of all the incapacity and corruption which royalty had exhibited in France during these hundred years, it had become very dear to the French people; and although persons like Louis XI. (1461–83) and Catharine de Medici, who actually governed France during the reign of her three sons, Francis II. (1559–60), Charles IX. (1560–74), and Henry III. (1574–89), were not fit to make royalty charming to the minds of the people, they were eminently fit to make it respected and feared. Charles IX. had the principal leaders of the Protestant party murdered at the massacre of St. Bartholomew in 1572; Henry III. had the principal leaders of the Roman Catholic party murdered one after the other. When (in 1589) Henry IV. ascended the throne and founded the *Bourbon* dynasty, he was obliged to devote the principal energies of the state to the difficult task of establishing harmony between the Roman Catholics and the Protestants. It was to this end that the EDICT OF NANTES (*q. v.*) was promulgated in 1598. Immediately after the death of Henry IV. in 1610, however, troubles broke out anew. The king, Louis XIII., was but a boy, and was ruled by his mother, Marie de Medicis. But about 1622 a great master of statecraft began to attract the attention of the country. CARDINAL RICHELIEU (*q. v.*), dominated by three great political ideas, controlled France until 1642. All his energies were directed toward subduing the political power of the nobles, breaking the predominant power of Austria, and destroying the political power of the Protestants. These three purposes will be found to furnish the key to all his acts. While he was successful he laid the foundation for the authority of Louis XIV.

During the first years of the reign of Louis XIV. (1643–1715) France was eminently prosperous, and held the most prominent place not only in European politics, but in European civilization. Louvois and Colbert were excellent ministers; the treasury was full; commerce and industry flourished; the army and navy were in an effective state; Turenne, Condé, and Luxembourg achieved great victories, and new provinces were added to the kingdom. The king was exceedingly prodigal, but his prodigality was accompanied by an elegance and taste which spread a magnificent and even blinding radiance around him; all other kings tried to imitate him. Corneille, Racine, Molière, Boileau, Bossuet, and Fénelon had the ear of the world, and dictated the taste in all other literatures. But after some years the true character of the absolute monarchy became apparent. In 1685 the king revoked the Edict of Nantes. Thereby the guaranty of religious freedom which was given to the Protestants by Henry IV. in 1598 was destroyed, and persecutions immediately began. Thousands of the most industrious and intelligent citizens of France were exiled. Some of the most prosperous branches of French industry stopped; the revenues decreased, and an uneasy feeling crept into the hearts of the people. The king's prodigality, however, did not decrease with his diminished revenues; on the contrary, his passion for stupendous buildings and gorgeous court magnificence grew stronger as he grew older. His second war (from 1689 to 1697) was not successful, and in his last (from 1700 to 1713) failure followed failure. Both were begun for reasons of mere vanity, but, although his armies were defeated time after time, his arrogance did not abate. In many districts of France food began to become scarce, but the king heeded it not. When he died he left a debt of 3,500,000,000 livres, a country utterly exhausted, a court more demoralized and more expensive than any other institution that modern civilization had ever seen, and a people deeply discontented, though perhaps as yet unconscious of the reasons of its discontent. Under his successors, Louis XV. (1715–74) and Louis XVI. (1774–93), the consciousness came, and with it the crisis.

The French court was the government of France. There was no constitution, and such fragments of a constitution as existed were either out of working order on account of disuse—the States General had not been summoned since 1614, the assembly of the notables not since the first year of Louis XIII., the Parliament of Paris had not met with full authority under Louis XIV.—or if capable of working, they worked against each other, and produced only confusion. The only valid authority was the king; he could interfere even with the courts of justice by his *lettres de cachet*. He governed France by the court and a great retinue of officials; 250,000 were employed to gather the land and income tax alone. There were about 4,000 offices which conferred nobility on their incumbents—that is, exemption from taxation and from military service. These offices were sold, and the sale was not a fraud on the administration, but a financial operation of the government. This people under this government consisted of three classes—the nobility, the clergy, and the third estate. The nobility comprised a long scale of different degrees of rank, from the forty-four peers of the realm to the swarms of parvenus who had received their nobility from an office; and this scale was expressed by an intricate system of etiquette. But all nobles —and their proportion to the whole population was as one to 250—were exempted from land tax, from military service, from contributions to the maintenance of roads, etc.; they paid only an insignificant class tax; and on such conditions the nobility held more than one-half of the soil of France, enjoying the right of hunting, exercising police superintendence, administering justice, etc. The Church owned a little over one-sixth of the soil, from which it derived an income of 160,000,000 livres a year, and on which it paid no regular taxes. Of these 160,000,000, 40,000,000 were received by the active servants of the Church, the curates, the priests; the rest was swallowed by the appanages of the prelates or spent in benefices which the king bestowed on the younger members of the noble families, and which enjoined no kind of service on the beneficiaries. The third estate had to bear the whole burden of the defense of the country, the whole burden of the defrayment of the public expense, and the whole burden of productive labor.

Between this people and this government stood a numerous class of writers—Voltaire, Rousseau, d'Alembert, Montesquieu, Diderot, and many more—whose glory has faded very much since it became evident that their positive ideas were wrong, but who conferred a great benefit not only on France but on Europe by their criticism of the actual state of affairs. With matchless eloquence, with irresistible wit, they showed that faults and demoralization on the one hand were the true causes of the misery and degradation on the other, and they taught men not to take the world as it was, but to try to make it what it ought to be. This was the situation to which the absolute monarchy in France came: a corrupt government, falling short of means by which to gratify its vicious appetites, a hard-toiling people, pinched by hunger and almost driven to despair; and between them a literature which told the starving man who it was that stole his food. The result could be nothing else than the *Revolution.*

Money was wanting; the state was on the verge of bankruptcy. The king first tried different ministers of finance: Necker, but he only revealed the state of affairs to the public, and informed the people that His Majesty had used 860,000,000 livres for his own person; Calonne, but he only increased the debt by his chimerical speculations, which destroyed much private capital and the last remnant of public confidence; Brienne, but he could do nothing when the nobility and the clergy absolutely refused to be taxed. The king then recalled Necker, and convoked the States General to meet at Versailles, May 25, 1789. In this assembly the votes were cast not by poll, but by class, and thus the third estate was completely overruled by the two privileged estates. The third estate protested against such an order of conducting business, and demanded a vote by poll. The two other estates refused. On June 17 the third estate constituted itself the National Assembly, and invited the two other estates to participate in its debates; on the 20th the Assembly pledged itself by oath not to separate until a constitution was made; and on the 23d it declared its membership inviolable. To this the king answered by dismissing Necker and ordering the concentration of a body of troops at Versailles; but in the meanwhile the nobility and clergy had given way at the king's request, and joined the third estate. On July 12 the first insurrection took place in Paris; on the 13th a national guard and revolutionary municipal boards were formed; on the 14th the Bastile was stormed; and on Aug. 4 the National Assembly—or, as it it was generally called, the Constituent Assembly—abolished all feudal and manorial rights. The royal princes fled, the emigration began. On Oct. 5 the mob of Paris, followed by the national guard, rushed to Versailles, and, after massacring the royal guard, carried the king and queen back to Paris, whither also the Constituent Assembly removed. July 14, 1790, the constitution was ready, the king took his oath on it, and those of the nobility and clergy who refused to do so were thrown into prison. Still the excitement and disorder in Paris increased every day, and on the frontier the royal princes organized corps of *émigrés*, while Austria, Prussia, Saxony, Great Britain, and Spain formed an alliance and offered the king their help against his subjects. June 20, 1791, he and the queen tried to flee, but were stopped at Varennes, brought back to Paris, and confined in the Tuileries. On Sept. 14 he had to take oath on a new constitution, and then the Constituent Assembly considered its work as done, dissolved, and gave place for the Legislative Assembly.

This Assembly met Oct. 1, 1791. Meanwhile the protests of the foreign courts against the constitution, the royalist insurrections in Calvados and Vendée, and the movements of the emigrants on the frontier caused terrible excitement in Paris. War was declared against Austria and Prussia, and when reports came of the defeat of the French armies, and when, moreover, the king, in confidence of help from the approaching Austrians, assumed a more decided attitude toward the Legislative Assembly, the excitement grew into wild fury. Armed bands broke into the Tuileries June 20, July 5, and Aug. 10. On the last occasion the Swiss guard was horribly massacred, and the king and the royal family were compelled to seek refuge in the Legislative Assembly, from which they were brought to the Temple as prisoners. Robespierre, Marat, and Danton swayed the Parisian populace through the club of the Jacobins and through Marat's paper. On the news of the Prussian invasion of Champagne and the fall of Verdun a tribunal of national defense was formed, the constitution abolished, the Legislative Assembly dissolved, and a National Convention convoked.

The National Convention, which met Sept. 21, 1792, consisted of two parties—the Jacobins, generally called the "Mountain," and comprising the most radical democrats—men without any definite ideas, but determined to carry the passion of the hour to its last consequences; and the Girondists, the representatives of law and order under the form of a constitutional monarchy, who were men of probity and talent. The Jacobins were in the majority, and on Sept. 22, France entered on the "First Day of Year I. of the Republic." Their power was still more strengthened by the success of the war. The Prussians were driven back, Dumouriez conquered Belgium, Custine crossed the Rhine, and Montesquiou entered Savoy. They felt that they were irresistible, and they pushed forward, trampling down everything which opposed them. The king was brought to trial Dec. 11, and executed Jan. 21, 1793. The Girondist leaders were arrested June 2, 1793, and executed Oct. 31. A committee of public safety was formed and invested with absolute power. The Convention passed a decree against all who were "suspected," and Barère declared that "terror" was the order of the day. Terror was indeed the weapon the Jacobins employed. In Bordeaux, Marseilles, and Lyons counter-revolutions took place, but they were put down with a cruelty and violence which the world had not seen since the days of the Roman emperors. The government was a perfectly unlimited despotism, exercised not by one, but by many. He whom the Parisian mob lifted on their shoulders became a despot for the hour, and he could do with lives and property as he liked. No institution could withstand these shocks. The Christian religion was formally abolished, and the worship of "Reason," represented on the occasion by a danseuse from the Opera, was introduced.

At this moment, however, a reaction began to set in. Not that the Reign of Terror ceased and the cruelties stopped. But the revolutionary frenzy had reached its culmination. The movement could go no further. In the excesses of Hébert and his party, especially in the abolition of religion, there was something which actually offended and disgusted Robespierre. He was thoroughly in earnest. He wanted a perfect democracy, with "liberty and equality," and he was willing to go through the terror of anarchy in order to break down the old social order and produce the new. But anarchy itself was not his ideal. Hébert and twenty of his party, the *Enragés*, were arraigned as vicious men and traitors to their country, and brought to the guillotine on Mar. 24, 1794. A worship of the Supreme Being was substituted for that of Reason. But the reaction, once begun, could not be stayed. Hébert was followed by Danton (Apr. 5), and Danton by Robespierre himself (July 28). The Jacobins were now without leaders, and on Nov. 11 their club was closed. During the first half of the year 1795 the Convention debated and adopted a new constitution, which placed the executive power in the hands of a Directory of five, and the insurrection against this new constitution, brought about by the intrigues of the radical democrats and the royalists, was successfully put down by the young general Bonaparte; the mob of Paris was disarmed Oct. 5.

The situation of the Directory was, nevertheless, by no means easy. From without it was attacked by Great Britain, Austria, and Russia. But it offered a vigorous and successful resistance to its enemies in the field. By regular conscription it brought 200,000 men into the field. The war was everywhere carried on in the enemy's territory, and the armies of the young republic seemed to be unconquerable. Foreign countries were subdued, and French ideas were impressed on Europe, not by mere eloquence, but by the aid of arms. In dealing with its domestic foes, however, the government of the Directory was much less successful. La Vendée was still in uproar, and when more peaceful and conciliatory measures were adopted the royalists returned and began their intrigues. At the election of 1797 they gained the majority in the representation, and the Government had to use very harsh—not to say terroristic—means in order to save itself. The Tuileries was surrounded with troops and cannons, and the royalist members were arrested. Their election was declared illegal, and they were banished from the country. Also the financial difficulties proved too great for the Government. In spite of the enormous sums which it drew from Belgium, Germany, and Italy, the Directory was unable to pay the public debt. It had to declare the state bankrupt and repudiate two-thirds of its obligations. Under these circumstances there arose a general feeling of the necessity of concentrating the Government in one single individual, and when (Nov. 9, 1799) Gen. Bonaparte overthrew the government of the Directory by military force and grasped the reins himself, most people in France approved of the measure. From the overthrow of the Directory to the defeat at Waterloo, June 18, 1815, Napoleon was the absolute ruler of France—first as consul (Dec. 27, 1799), then as emperor (Dec. 2, 1804). His reign was the most brilliant period of French history. An uninterrupted series of great victories—Marengo, Austerlitz, Jena, Wagram—made France the undisputed arbiter in European politics, removed her frontiers to the Elbe and the Adriatic Sea, and turned a stream of gold and treasure into her lap. This changed, of course, after the catastrophe in Russia (1812), the battle of Leipzig (Oct. 19, 1813), and the abdication (Apr. 4, 1814). (See NAPOLEON I.) Nevertheless, in spite of the humiliations and the exhaustion which those years brought along with them, France was not simply recovering, but actually developing during the period from the restoration of the Bourbons, in 1815, to their final expulsion, in 1830—that is, in the reigns of Louis XVIII. and Charles X. But the Bourbons had learnt nothing and forgotten nothing during their exile of more than twenty years; and when, under their hands, the reaction gradually assumed the character of arbitrariness and despotism, the revolution broke out, July 25, 1830. It ended with a mere change of dynasty, but Louis Philippe also proved unsuccessful in quieting the restless spirit of the French people. His so-called policy of resistance provoked another revolution, Feb. 5, 1848, and he had to flee. It was evident that the spirit of revolution was still a very powerful force in the French nation. It was the presence of this spirit which gave the rich and comfortable middle class of the French people a dread of the future, and enabled Napoleon III. to trample down the republic (Dec. 2, 1851) and establish a new monarchy (Dec. 2, 1852). It should also be noticed that one of the most effective means which the new ruler employed to keep down the political aspirations of the people and support his own despotism was just this very dread for what seemed to be the last consequences of liberalism. Seldom, however, has a political undertaking of any magnitude ended in so shameful a manner as the reign of Napoleon III. After the Prussian victory of Sedan (see FRANCO-GERMAN WAR) it became more and more apparent that his whole foreign policy had been a senseless casting about for the mere purpose of producing or sustaining an illusion. The humiliation of Sedan was followed by the paroxysm of the Commune. The republic established in 1870 after the deposition of Napoleon III. has lasted longer than any former attempt at establishing a republic in France. Under the presidencies of Thiers and MacMahon events were often stormy enough. Royalist plots, legitimists, Orleanists, and Bonapartists were much spoken of. Under the presidency of Grévy the times were calmer. Under that of CARNOT (*q. v.*) great financial scandals connected with the Panama Canal scheme were brought to light, and at times the Government seemed to be in peril. Carnot was succeeded by CASIMIR-PÉRIER (*q. v.*), who, however, resigned Jan. 15, 1895. Two days later FÉLIX FAURE (*q. v.*) was chosen to succeed him. During this period the foreign policy of France has limited itself to colonization and to development of military resources with a view to possible recovery of the provinces lost in the Franco-German war. See FRANCE, HISTORY OF, in the Appendix.

AUTHORITIES.—Of the works narrating nearly or quite the entire history of France the most important are Martin, *Histoire de France* (16 vols., 1855–60); Michelet, *Histoire de France* (17 vols., 1833–66); and Guizot, *Histoire de France* (6 vols., 1870). Of Martin and Michelet parts only have been translated and published in English. Guizot appeared in English simultaneously with the French edition. Of works on special periods Guizot's *Histoire de Civilisation en France* (also in English) is of the first importance for the period of the Middle Ages. For the same period Coulanges's *Histoire des Institutions politiques en France* is also very important. For the period of the Reformation the works of Mignet, Baird, Poole, White, Freer, Segretain, Poirson, Robson, and Chéruel are important. For the period of the Revolution the number of works is too great for enumeration. Of the first importance, however, are the writings of Lanfrey, Tocqueville, Thiers, Blanc, Taine, von Sybel, Mignet, Alison, Carlyle, and Jung. For the post-revolutionary period the most useful works are Viel-Castel, *Histoire de la Restauration*; Blanc, *Histoire de Dix Ans*; Hillebrand, *Geschichte Frankreichs von der Thronhesteigung Louis Philippes bis zum Falle Napoleon III.*; Guizot's and Tocqueville's *Memoirs*; Delord, *Histoire du Second Empire*; Jerrold, *Life of Napoleon III.*; Van Laun's *The French Revolutionary Epoch*; and Adams's *Democracy and Monarchy in France.* For a fuller bibliography, see Adams's *Manual of Historical Literature.*

Revised by C. K. ADAMS.

Francesca, fraan-ches'kaa, PIETRO, della: painter; b. at Borgo San Sepolcro, in Italy, in 1398. He was also called Pietro Borghese after his father. He first painted several small pictures for the Duke of Urbino, which excited great admiration. He then went to Pesaro, Ancona, and Ferrara, where he decorated many rooms in the old palace, now destroyed. At Ferrara there are only the frescoes of the chapel of St. Augustine still remaining, and they are spoiled by the damp. Nicholas V. invited him, together with Bramante, to work in the Vatican, and here his work was also destroyed, as Raphael painted over the frescoes. After executing his commission in Rome Francesca returned to Borgo San Sepolcro, where he produced exquisite work, as also at Arezzo and at Loreto, with Domenico Veneziano. This great painter lost his eyesight at the age of sixty, and gave himself up to the study of mathematics. He was the first to lay down the principles of perspective and to imitate in painting different effects of light, to note intelligently the muscles in the nude figure, to prepare models in clay to paint the figures from, and to study drapery on them by putting it on wet. D. in 1484. W. J. STILLMAN.

Franche-Comté, fraansh'kōn'tā': one of the old provinces of Eastern France; now divided into the three departments of Doubs, Haute-Saône, and Jura.

Franchise [from O. Fr. *franchise*, freedom, privilege; deriv. of *franc, franche*, free, whence Eng. *frank*]: in law, a particular privilege conferred by government on individuals or corporations which does not belong to the citizens of a country generally by common right. In Great Britain the varieties of franchise are very numerous, and include such rights as these: to have wrecks, estrays, treasure-trove, or forfeitures; to hold fairs or markets; to establish and maintain ferries; to have a forest, chase, park, warren, or fishery, etc. In the U. S. the classes of these special privileges are greatly reduced in number, and they are, almost without exception, vested in corporations. The most usual and important are the privileges of maintaining ferries, bridges, turnpikes, railways, telegraph and telephone lines, and the right to be a corporation for any purpose.

Nature of a Franchise.—A franchise is created either by express legislative grant or by prescription, which presupposes a grant, and hence is of the nature of an agreement or contract between the State and the grantee or possessor of the franchise, and the latter thereby assumes certain obligations as a consideration for the rights which the former confers upon him. The rights accruing under this contract are generally included in law among incorporeal hereditaments. But as it is usually conferred upon a corporation, which is regarded as having a perpetual existence, it can scarcely ever be said to pass as an inheritance. It has, however, this quality of inheritance when vested in an individual, and it clearly indicates the nature of a franchise as a right of property, an incorporeal hereditament being regarded as real estate.

Duties or Obligations Imposed upon the Grantee.—The duties which are imposed upon, or the obligations assumed by, the grantee of a franchise depend upon the nature of the franchise bestowed. He must in any case use his privileges only in the way and to the extent contemplated in the grant, and in the exercise of these is governed by the law of the land. In the case of grants which bestow privileges, the exercise of which consists in rendering some service to the public for a consideration, the obligations assumed are to serve the public in the way and to the extent which he may reasonably be supposed to have agreed to do in accepting the franchise. Thus if the privilege be to construct and maintain a common highway or provide any means of public transportation, there is annexed to the grant a power of taking tolls from those who enjoy the superior facilities afforded, as a means of remuneration; and the owner of the franchise must in return provide proper accommodations for the public, take all reasonable measures to promote the safety and comfort of travelers, and be ready at all proper time to give them passage. For any violation or neglect of these duties he may be made to respond in damages, or he may even be deprived entirely of the power with which he had been intrusted.

Rights of the Grantee.—The rights of the grantee of a franchise are the same as those which he would have in the case of any other property, subject, of course, to the limitations imposed by the act bestowing it, and those arising from the nature of the particular franchise. As is said above, the franchise is in the nature of a contract, and the rights of the grantee are such as arise from the terms of the contract, and may be protected and enforced in the same way and to the same extent as any other rights of a like nature. Thus a corporation having a franchise to maintain a public ferry may obtain damages from any one illegally interfering with their full enjoyment of the franchise, and enjoin any further acts of interference. On the other hand, as an example of the limitations upon the rights of the grantee arising from the nature of a franchise, may be mentioned the principle, established by the weight of authority, that a corporation can not mortgage, sell, or transfer its franchises unless expressly authorized thereto by the Legislature, although on this point the cases are not all agreed. It is fair, however, to assume that in granting a franchise to be a corporation the State has regard to the character of the grantee, and it is not unreasonable to hold that as a due performance of the corporate duties is the consideration of the grant of a franchise, any contract which disables or prevents the corporation from discharging its functions, by undertaking without the consent of the State to transfer to another the rights and powers conferred by the charter, and to relieve the grantee of the burden which the charter imposes, is void as against public policy.

For the same reason it is held that at common law the franchises of a corporation can not be seized and sold on execution. Creditors can not so enforce their claims as to render the corporation incapable of performing its public duties. The common law, however, has been changed by statutes, so that, generally, on the foreclosure of a railroad mortgage the purchaser acquires the right to operate the railroad; and many charters, and the general laws of many of the States, expressly authorize corporations to mortgage or alienate their franchises. When a mortgage or transfer of corporation franchises is made without the authorization of the State, it may be ratified by subsequent legislation.

Rights of the State or Government against the Grantee.—So long as the grantee of a franchise performs the obligations assumed under the franchise, the State is subject to the same limitations and restrictions as respects depriving him of it, or destroying it, that exist with respect to any other species of property. In the U. S. the Dartmouth College case established the principle that the grant of a franchise in the charter of a corporation creates a contract the obligation of which is protected by that clause of the Constitution of the U. S. which declares against impairing the obligation of contracts by subsequent legislation. But in many charters, or acts of incorporation, there are various provisions which are regarded as matters of law and not of contract, and which are therefore subject to modification or repeal; and there are certain rights of the State or Government subject to which it is held that all franchises are granted, even though expressly excepted from their operation by the terms of the grant.

One of these is the right of *eminent domain*, in the exercise of which a State may always destroy or take away a franchise for the creation of other franchises or public works, upon making adequate compensation. (See EMINENT DOMAIN.) An interesting question has frequently arisen in the courts as to whether the Government in creating other franchises which would not directly destroy or divest any previously existing right of the same kind, but would seriously interfere with its exercise and diminish its value, as by establishing a new ferry or bridge in the immediate neighborhood of another, is infringing upon the franchise first granted in such a manner as to entitle the grantee to compensation. It has been asserted by some jurists that at common law any such infringement upon franchises was a nuisance, which might be prevented by injunction or be made the subject of an action for damages. But the U. S. courts have decided that there is in such cases no violation of proprietary rights, and that the State is under no obligation to make recompense. Public grants are to be construed strictly, and no implications of the kind under consideration are to be annexed to them. In some instances express terms are inserted excluding all interference within a specified distance, and a protecting stipulation is thus made expressly a part of the contract, which the State can not violate without making compensation.

Another right of this nature is that of exercising the *police power*, subject to which franchises are always granted. The courts have settled it that the police power of States can not be bargained away.

A third is the right to *alter legal remedies*. Every franchise is held subject to legislation affecting remedies; yet the State must give some remedy, and one which is substantially equivalent to that which was provided by law when the franchise was granted. Any law which under the pretense of changing the remedy really would deprive the grantee of some right for which he contracted in accepting the franchise would be unconstitutional, as being an impairment of the obligation of contracts.

The right to amend or repeal a charter bestowing a franchise is now, however, reserved in nearly all cases by the State. But even where this is the case the reserved power to amend or repeal has its limits. The power to alter or modify a charter is not an arbitrary power, but is restrained to the powers and franchises granted by the charter. The courts hold that the alterations must be reasonable, and that they must be made in good faith and be consistent with the scope and object of the act of incorporation. It does not reserve the right to change the object of the incorporation, or to substitute another for it. An alteration or modification is necessarily of the grant or thing to be altered or modified, and can not be done by substituting a different thing.

Remedies.—There are three remedies available for the enforcement of the public duties of a corporation: *mandamus*, *quo warranto*, and indictment. A corporation may be compelled by *mandamus* to perform duties specifically and plainly imposed upon it. *Quo warranto* is a proper remedy in cases of usurpation or illegal uses of franchises.

In political law the word "franchise" is used as an equivalent to the right to vote for candidates at a public election. The right of citizens of the U. S. to vote is now, to a certain extent, guarded by the U. S. Constitution, which provides (Fifteenth Amendment) that it shall not be denied or abridged by the U. S., or by any State, on account of race, color, or previous condition of servitude, and that Congress shall have power to carry this provision into effect by appropriate legislation. See VOTE.

Revised by HENRY WADE ROGERS.

Franchise Tax: See FINANCE.

Francia, fraan'chaa, FRANCESCO: painter; b. at Bologna in 1450; his family name was Raibolini. Of artisan extraction, he was placed with a goldsmith, and learned the art in all its branches to perfection. He was especially successful with coins and medals, was made director of the Bolognese mint, and designed all its coins during the government of the Bentivogli and of Julius II. Having made the acquaintance of Mantegna, he became anxious to paint, and in 1490 he produced his first picture for the Misericordia, a

Madonna in oil-color. Giovanni Bentivoglio, admiring this picture, made him paint him another Madonna for one of his chapels, and invited him, together with other Ferrarese masters, to paint in his palace. He soon became a famous and very popular painter, and received commissions from Lombardy and Tuscany, while his works in his own country are very numerous. His Madonna pictures were especially famous. He died in 1517.—His son GIACOMO, born at the end of the fifteenth century, was his father's pupil, and his works are sometimes taken for Francesco's. W. J. STILLMAN.

Francia, fraan'sē-ăā or (Span. pron.) fraan'thē-ăā, JOSÉ GASPAR RODRIGUEZ, called Dr. Francia: dictator; b. in Asuncion, Paraguay, in 1761. His father was a Brazilian named França, who had settled near Asuncion. José Gaspar graduated in canon law at the University of Cordova, and became an advocate in his native town, holding some minor public offices; he acquired a reputation for great learning among the ignorant people, but attained no real distinction before his fiftieth year. When Paraguay revolted against its Spanish governor (May 15, 1811), Francia was made a member of the governmental junta; he quickly became the leader, and from that time was virtually ruler of Paraguay. The country formally separated from Buenos Ayres Oct. 12, 1811, and Francia and Fulgencio Yegros were chosen consuls. Yegros, from the first, was a cipher in the government. In 1814 Francia was made dictator for three years, and in 1817 dictator for life. He ruled as an absolute despot, without ministers, and with no other law than his own will. Business and agriculture were managed as he directed, and in fact the whole country was treated as a private domain and the people as serfs. His policy was to cut off Paraguay from intercourse with the outside world, and to make it self-supporting; to this end foreign commerce was almost prohibited; Paraguayans were not allowed to leave the country, and the few foreigners who entered it were kept there for years. Several real or imagined conspiracies against him were put down by the imprisonment and execution without trial of scores of persons. His own friends were persecuted. D. in Asuncion, Sept. 20, 1840. HERBERT H. SMITH.

Franciabigio, fraan-chăā-bee'jō, properly **Francesco di Cristofano**: a Florentine painter; b. 1482; a pupil of Albertinelli. He afterward became an imitator of Andrea del Sarto, and in a friendly way often tried to compete with him. In the cloister of the Annunziata he painted a *Marriage of Our Lady* beside certain works of Andrea, which compared well with them, though it was never finished, for the monks angered him by uncovering it before the right time, and he injured it with a hammer and left it unfinished. At Scalzo and Poggia a Caiano his work was again executed beside that of Andrea, and although he does not equal him, no one can deny his having great gifts. D. in 1524. W. J. STILLMAN.

Fran'cillon, ROBERT EDWARD: novelist; b. in Gloucester, England, in 1841. He was graduated at Trinity Hall, Cambridge, in 1862, and admitted to the bar in 1864. Of his numerous novels the best known is *Under Slieve-ban* (1881).

Francis I.: King of France; b. at Cognac, Sept. 12, 1494; son of Charles, Count of Angoulême; succeeded his cousin and father-in-law, Louis XII., Jan. 1, 1515. In the following July he set out for the conquest of the Milanese territory. He won the great battle of Marignano, the "battle of the giants" (Sept. 14–15), and was knighted on the field by Bayard. In 1519 began his rivalry with Charles V. in the contest for the imperial crown and the control of Italy. In June, 1520, he met Henry VIII. of England on "the field of the cloth of gold," between Guisnes and Ardres. In 1522 he began the war against the emperor, the pope, and England, most unwisely attacking at once Navarre and the Netherlands. Prosper Colonna, at the head of the Italian troops, rapidly dispossessed Francis of his Italian possessions, except Cremona; the French were routed in Navarre; and on the eastern frontier the only advantage was the check given to Charles at Mézières. Meanwhile, the English invaded the north; the constable Bourbon went over to the enemy; Bonnivet was driven out of Italy; Bayard was slain, Provence overrun by the Germans, and the queen died. Francis, however, rapidly cleared Provence of his enemies, and followed them into Piedmont, but was defeated and captured at the great battle of Pavia, in 1525. He was kept a close prisoner at Madrid for one year; but England, Venice, Rome, and Genoa demanding his release, the emperor liberated him, after exacting the most humiliating conditions. The war was at once renewed in Italy; Rome was sacked by the constable Bourbon, the pope imprisoned, but the French army under Lautrec was destroyed before Naples by a loathsome disease hitherto unknown in Europe. In May, 1529, both parties were exhausted, and the Peace of Cambray ensued, though the war broke out afresh in 1534 and 1542, each time with apparent but not permanent advantage to France. The latter part of the king's reign was marked by terrible persecutions of the Protestants, in which many thousands of his subjects were either slain or banished. Francis died at Rambouillet, Mar. 31, 1547.

Francis II.: of France; b. at Fontainebleau, Jan. 19, 1543; the son and successor of Henry II.; in 1558 married Mary Queen of Scots, the niece of the Guises, who when he came to the throne in 1559 swayed completely the policy of the court, and renewed the persecution of the Huguenots, especially after the discovery of the conspiracy of Amboise. The reign is taken up with court intrigues, in which the queen-mother, Catharine de Medici, and the Guises struggled for the mastery, which the former finally secured at the time of the king's fatal illness. Francis died at Orleans, Dec. 5, 1560.

Francis I.: Emperor of Germany; b. Dec. 8, 1708; succeeded his father, Leopold, as Duke of Lorraine in 1729, and in 1735 received Tuscany in exchange for Lorraine. In 1736 he married the Archduchess Maria Theresa. In 1741 he was declared co-regent with his wife, and in 1745 was chosen emperor. Most of his attention was given to Tuscany, and Maria Theresa was the true sovereign in Germany. D. at Innspruck, Aug. 18, 1765.

Francis II. of Germany and **I.** of Austria: son of Leopold II. and grandson of Francis I.; b. at Florence, Feb. 12, 1768; succeeded his father in 1792, in which year war was declared against him by France at the beginning of the Revolution. Napoleon's brilliant operations in Northern Italy followed, and the Treaty of Campo Formio (1797) robbed him of Belgium, the Milanese, and part of the Rhine provinces. In 1799–1800 he joined Russia and Great Britain in another war, but Moreau in Germany and Napoleon in Italy (Marengo, June 14) brought this war to a termination favorable to France in 1801. In 1804 Francis took the title of Emperor of Austria, joined the third coalition of 1805, and was compelled by the calamities of Ulm and Austerlitz to renounce his title of Emperor of Germany (1806), together with his claim to Venice and the Tyrol. This was the end of the Holy Roman Empire. In 1810 his daughter, Maria Louisa, was given by him in marriage to Napoleon. He joined the allies, and took part in the battle of Leipzig and the occupation of France in 1813. Napoleon's final overthrow left Francis stronger than ever before. He became a leading figure in the Holy Alliance, and Austria's name was for years after the symbol of despotism and reaction against liberal politics. D. at Vienna, Mar. 2, 1835.

Francis I.: King of the Two Sicilies; b. at Naples, Aug. 19, 1777; became Duke of Calabria in 1799; succeeded his father, Ferdinand I., in 1825, having previously been associated with the constitutionalist and revolutionary party, and attempted constitutional government in Sicily. Nevertheless, his reign was one of cruel tyranny and corruption. D. at Naples, Dec. 8, 1830.

Francis II.: of the Two Sicilies (FRANCESCO D'ASSISI MARIA LEOPOLD); b. at Naples, Jan. 31, 1836; succeeded his father, Ferdinand II. (Bomba), in 1859, and adopted his father's reactionary policy. His realm was invaded and quickly overrun by Garibaldi's forces in 1860, and when Gaeta, his last stronghold, was surrendered (1861), Francis escaped to Rome and later to France, where he lived in retirement, though for a time he organized fruitless expeditions against the new kingdom of Italy. D. Dec. 27, 1894.

Francis Borgia, SAINT: general of the order of Jesuits and Duke of Gandia; b. at Gandia, Spain, in 1510: early showed an inclination for the monastic life, but his father, thinking to divert him from that career, placed him in the court of the Emperor Charles V., whom he accompanied on his African expedition. The emperor made him Viceroy of Catalonia, but Borgia entered into correspondence with Loyola, and in 1546 resolved to join the order of Jesuits, of which he became general in 1565. His zeal as a preacher and worker on behalf of the order caused him to be styled its "second founder." D. in 1572 and was canonized by Pope Clement X. in 1671.

Francis Ferdinand: heir to the Austrian throne; son of the Archduke Charles Louis by his second wife, Princess

Marie Annonciata, daughter of Ferdinand II., King of the Two Sicilies; b. at Gratz, 1863. By the suicide of the Crown Prince Rudolph, Jan. 28, 1889, Charles Louis became heir to the throne, but renounced his rights of succession in favor of his son.

Francis, James Bicheno: hydraulic engineer; b. at Southleigh, England, May 18, 1815. He went to New York in 1833 and soon after was engaged on railroad surveys in New England. In 1834 he was associated with George W. Whistler in the hydraulic improvements near the city of Lowell, Mass., and in 1837 he was appointed chief engineer for the proprietors of the locks and canals on Merrimack river. He held this position until 1884, and later was consulting engineer on the same work. He made many important experiments on turbine wheels, on weirs, and on the flow of water in tubes, which have been of great value to the engineering profession. The results of these are mostly given in *Lowell Hydraulic Experiments* (1855; republished with additional data in 1868 and 1883). He was also the author of many papers in technical journals, and of a work on *The Strength of Cast-iron Columns* (1865). During 1881 he was the president of the American Society of Civil Engineers. D. Sept. 18, 1892.

Francis, John M.: journalist and diplomatist; b. in Prattsburg, Steuben co., N. Y., Mar. 6, 1823. After receiving a common-school education he was at the age of fourteen put as apprentice to the printing business. In 1843 he was employed as editor of the *Wayne Sentinel* at Palmyra, N. Y. After studying law for some months he became in 1845 leading editorial writer of the Rochester *Advertiser*, and in 1846 performed a similar service for the Troy *Budget*, of which he was afterward editor and associate proprietor. After serving on the Troy *Post* and the Troy *Whig*, he established the Troy *Times* in 1851, and was afterward controlling proprietor of that journal. In 1871 he was appointed by President Grant U. S. minister to Greece, which position he resigned Nov. 17, 1873. Became U. S. minister to Portugal, July 7, 1882, and was minister to Austria-Hungary 1884–85. D. at Troy, N. Y., June 18, 1897.

Francis, John Wakefield, M. D., LL. D.: b. in New York, Nov. 17, 1789; graduated at Columbia College in 1809; in 1811 received his medical degree at the New York College of Physicians and Surgeons; published with Dr. Hosack (1810–14) the *American Medical and Philosophical Register*; in 1813 became Professor of Materia Medica in Columbia College and lecturer in the College of Physicians and Surgeons; went to Europe and studied under Abernethy; returned to New York, and held in the last-named school successively the chairs of the Institutes of Medicine, of Medical Jurisprudence, and of Obstetrics; was Professor of Obstetrics in the Rutgers Medical College 1826–30. D. in New York, Feb. 8, 1861.

Francis Joseph: Emperor of Austria and King of Bohemia, Hungary, etc.; b. Aug. 18, 1830; son of the Archduke Francis Charles and nephew of Ferdinand I., whom he succeeded in 1848. The Franco-Italian war of 1859 and the Prusso-Italian war of 1866 despoiled him of his Italian possessions, but the Treaty of Berlin, 1878, allowed him to annex Bosnia and Herzegovina. In July, 1890, his daughter, the Archduchess Valérie, was married to the Archduke Francis Salvator. The emperor's only son, the Crown Prince Rudolph, having committed suicide on Jan. 28, 1889, the emperor's brother, the Archduke Charles Louis, became heir, but he relinquished his right of succession in favor of his son, the Archduke Francis Ferdinand, who therefore is heir-apparent. See Francis Ferdinand.

Francis (Saint) **of Assisi**, as-see'see: founder of the orders of Franciscans in the Roman Catholic Church; was b. in 1182 at Assisi, and named Giovanni Bernardone, but called Francesco by his father Pietro, a rich merchant who traded much with France, because of the child's proficiency in the use of the French language. He was a thoughtless, gay youth, and served as a soldier against the troops of Perugia, but was taken prisoner and confined for a year, 1201–02. This imprisonment, and a consequent sickness, led him to make a vow to renounce the world—a vow which he soon forgot. But warned, as he conceived, by a voice from heaven, he took a final vow of poverty, and formally refused all inheritance in his father's property, 1205. He now begged money for the repair of the churches, washed the feet of beggars and lepers, and kissed their sores, clothed himself in a robe of serge sewed with packthread and tied about the waist with a rope; ate the meanest food, and covered it with ashes, and wept and fasted almost continuously; slept on the ground, and used a stone for a pillow. In 1209, having a few personal followers, he drew up a monastic rule for them, which was in 1210 approved by Innocent III., and in the same year Francis was made a deacon, the highest clerical position he would receive. In 1212 he was joined by St. Clara and her two sisters, the original Clarisses or Poor Clares of the Order of St. Francis. In 1219 he joined the crusaders at Damietta; in 1221 he founded the Tertiary Order. On Sept. 17, 1224, as is asserted, he had a vision of Christ, and received upon his hands, feet, and sides the *stigmata*, or marks resembling the wounds of Christ. (See Stigmatization.) Among his numerous reputed miracles was the healing of the infant Bonaventura, afterward a distinguished saint. St. Francis died in Assisi, Oct. 4, 1226, and was canonized in 1228. See his *Life* by Mrs. Oliphant (London and New York, 1871; n. e. 1877). His *Works* appeared in English translation (London, 1882).

Francis, Sir Philip, K. B.: politician; b. in Dublin, Oct. 22, 1740; was the son of Philip Francis (1700–73), an Anglican clergyman and translator of Demosthenes and Horace. Young Philip entered public life in 1756, under the patronage of Henry Fox (see Holland, Lord), as a placeman in the state department, and held afterward various places in the civil service at home and abroad until 1772. He was a member of the council for Bengal 1774–80, and the constant opponent of Hastings, by whom he was badly wounded in a duel. He entered Parliament in 1784, and finally left it in 1807. At present he is chiefly remembered as perhaps the author of the *Junius* letters. (See Junius.) D. in London, Dec. 22, 1818. None of his acknowledged writings are now important.

Francis'cans [from Mediæv. Lat. *Franciscus*, Franciscan, deriv. of *Franciscus*, Francis, liter. Frankish, deriv. of *Francus*, a Frank], **Minorites** [deriv. of Lat. *minor*, less] (*Fratres Minores*), **Gray Friars** (in England and Ireland), sometimes called also **Seraphic Brethren**: one of the great mendicant orders of the Roman Catholic Church; dates from 1209, when Francis of Assisi (*q. v.*), its founder, was joined by two companions at the Church of Sta. Maria degli Angeli, which was afterward called by him "Portiuncula," "little inheritance." In that same year the order was provisionally sanctioned by Innocent III., commended to the favor of the fifth Lateran Council in 1215, and finally established by Honorius III. in 1223. The rule was given in 1210. The female order of Clarisses (Poor Clares), which took its rule from him in 1224, dates from 1212. His Tertiaries date from 1221. And so he is called the founder of *three* orders. Mediæval Europe owes much to the Franciscans. They went everywhere, and were like flames of fire wherever they went. First of all, they roused the masses. Poor men, wearing nothing but brown frocks girded about the waist by bits of rope, brought the gospel home to the poor. By and by they made themselves felt in every walk of life. Assisi became the acknowledged capital of Christian art. Thomas de Celano, author of *Dies Iræ*, and Jacopone da Todi, author of *Stabat Mater*, were both of them Franciscans; pontiffs like Nicholas IV., Alexander V., and Sixtus V. were Franciscans; but, above all, some of the greatest and best of the schoolmen, such as Roger Bacon, Duns Scotus, Bonaventura, Alexander of Hales, and Ockham, belonged to the same order. The war between Thomists and Scotists was still more a war between Dominicans and Franciscans. Even in the lifetime of St. Francis strife arose in regard to the strictness of the rule. The extreme asceticism which originally inspired the order has repeatedly reacted against its declining discipline. Hence such temporary offshoots as the Cæsarines (1236–56), the Celestines (1294–1307), and the Clarenines (1302–1506). The Capuchins (dating from 1525) are still in existence. Hence also, especially, the great schism of 1368, which established the two branches of milder Conventuals and more rigorous Observants. The numerical strength of the order was greatest about fifty years after its foundation, when it had between 7,000 and 8,000 convents and nearly 200,000 monks. In the fifteenth century it declined, and was again greatly weakened near the close of the eighteenth century. At present the number of monks is nearly 100,000, and they are found in almost every part of the world.

The literature of the subject is voluminous. See Léon, *L'auréole séraphique, vie des saints et bienheureux des trois* *ordres de St. François* (Paris, 1883, 4 vols.). Cf. the history of the order, called the *Annales Minorum*, by Luke Wadding (2d ed. Naples, 1731–1860, 24 vols.).

Revised by S. M. Jackson.

Francis de Paul, Saint: b. at Paola, in Calabria, in 1416; became a Franciscan in youth, but assumed the life of a hermit near his native town. He soon acquired a wide fame by the terrible austerities of his life, and his reputed miracles brought to him many followers. In 1436 he established the order of Hermits of St. Francis, afterward called Friars Minims, Bon Hommes, and Fathers of Victory, which has now only a few members. In 1482 he visited Louis XI. of France, who hoped in vain to be cured by him of his long and at last fatal illness. He remained in the service of Charles VIII. and Louis XII. of France, and died at Plessis-les-Tours, Apr. 2, 1507. He was canonized in 1519.

Francis de Sales (Fr. pron. -saal'), Saint: b. at the Château de Sales, near Annecy, Savoy, Aug. 21, 1567, of noble parentage; was educated at Paris and Padua, and in the latter university became a doctor of theology and of laws; practiced law reluctantly, and at last won his father's consent to his entrance upon the clerical life, and as deacon and provost of the cathedral of Geneva won fame as an eloquent preacher; became a priest in 1593; went on a mission to Savoy, whence in 1598 he procured the expulsion of certain Protestant ministers. He was then sent by the pope to convert Beza, to whom he offered a cardinalate, but all in vain. In 1599 he became coadjutor, and in 1602 Bishop of Geneva. In 1610 he founded, with Madame de Chantal, the order of the Visitation, with the mother-house at Annecy. D. at Lyons, Nov. 28, 1622. He was distinguished for zeal, charity, purity, eloquence, and personal excellence. He was canonized in 1665, and made œcumenical (the eighth Latin) doctor of the Church in 1877. His complete works appeared in six volumes, Paris, 1868: in Eng. trans. London, 1883, *sqq.* (vol. iv., 1889); his *Introduction to the Devout Life* is one of the most famous devotional treatises, and has been translated into all literary languages, e. g. Eng. trans. New York, 1885. See his *Life* by J. P. Camus (n. e. London, 1880).

Francis Xavier, zăv'i-*er*, Saint Francisco de Xavier: Jesuit missionary; b. of a noble family at the castle of Xavier, in Navarre, Apr. 7, 1506; was educated at the Collège Sainte-Barbe, Paris; taught philosophy with applause in the College of Beauvais, and received the doctorate in philosophy from the Sorbonne (1530). In 1534 he joined the new society proposed by his fellow-student and compatriot Loyola, and in 1537 they, with a few others, the germ of the future Society of Jesus, went to Rome and received the papal benediction upon their new enterprise. He now toiled with zeal in the Italian prisons and hospitals, and in 1541 was sent by Loyola to Goa, India. During ten years in India, Ceylon, Japan, and Malacca he baptized, it is said, more than 1,000,000 persons, and planted the faith in fifty-two kingdoms. He died of fever, in the island of Hiang-Shan, near Macao, China, Dec. 2, 1552, and was canonized in 1622. Many miracles are ascribed to him by Roman Catholic writers. See the *Life* of this saint by D. Bartoli (1666; Eng. trans. London, 1858); by the Protestant H. Venn (London, 1862); and by the Roman Catholic H. J. Coleridge, with his *Letters* (1872–73, 2 vols.).

Franck, fraank, or (as he styled himself) **Franck von Wörd**, Sebastian: mystic and historian of the Reformation era; b. at Donauwörth, 1499; embraced the Reformation but not any of its sects, although inclined to the Anabaptists. He pursued a checkered literary career in Nuremberg, Strassburg, Ulm, and Basel, and died in the last-named city, 1543. His best-known writings are his *Chronica* (Strassburg, 1531) and *Sprichwörter* (Frankfort, 1541). See his *Life* by O. Haggenmacher (Zürich, 1886).

Francke, fraan'k*e*, August Hermann: German Lutheran divine and philanthropist, and one of the principal propagators of the Pietist movement in Germany; b. in Lübeck, Mar. 22, 1663; commenced his studies at Erfurt 1679, continued at Kiel, and finished them at Leipzig in Hebrew, Greek, and theology. He delivered theological lectures in Leipzig 1689–90, was *diakonus* in Erfurt 1690–91, but was summarily dismissed in consequence of his criticisms upon the "orthodox" clergy; in 1692 was called to the new University of Halle as Professor of the Greek and Oriental Languages, and as pastor of the suburban town of Glaucha. Breithaupt and Lange were his associates in the faculty and in the spirit of practical energy in which he followed up the work of Spener (*q. v.*). In 1715 he became pastor of the Church of St. Ulrich in Halle. He was founder of the greatest orphan-house of Protestant Europe, of a free school, a free table for students, and of a seminary for teachers. In 1698 these institutions were brought together in one great edifice in the city of Halle. The whole was sustained by private beneficence or by the judicious labor connected with the orphan-house. Among its useful appendages was a publishing establishment, from which were issued many valuable books, especially the cheap Bibles of the Canstein Institute. After his death, in Halle, June 8, 1727, the work was carried on by his son and by Frelinghausen, his son-in-law; but he can by no means be held responsible for the separatistic tendencies which then became visible. The best biographies of Francke are by H. E. F. Guericke, Halle, 1827 (translated into English, London, 1837); and G. Kramer (Halle, 1880–82, 2 vols.).

Franco-German War: the conflict between France and Germany which occurred in 1870–71. Under the statesmanlike leadership of Bismarck, Prussia wholly gave up, in 1866, its modest and somewhat ambiguous attitude of former days, and on the basis of the very decided impression which its victory over Austria produced it took the hegemony in Germany. But thereby the old enmity between France and Prussia was immediately rekindled. The government of Napoleon III. could not but feel depressed by reason of the astonishing success of Prussia. It was itself based on the success of its foreign policy. Its important reforms in the field of political economy had found only a cold reception, and Napoleon understood that it would be very difficult for him to maintain himself as Emperor of France when he could not maintain the French empire as leader of Europe. Perpetually stirred up and irritated by the opposition, the national feeling of France began to rise against a ruler who suppressed her freedom without increasing her fame and power. The French people felt its pride offended, and the cry was heard, "Revenge for Sadowa!" Thus after 1866 the imperial government tried its utmost to put the French army with the greatest possible rapidity on a footing which would enable it to declare war against Prussia, while at the same time it endeavored by diplomatic means to gain such concessions from Prussia as might look like compensations for the aggrandizement of that power. It failed, however, in both plans. The introduction of the Chassepot guns was carried through with great rapidity; at the end of 1869 the entire body of infantry was provided with this weapon. But the reorganization of the army met, in general, with so much opposition from the side of the representatives of the people that, especially after the death of the energetic Marshal Niel, only a few reforms of any consequence could be effected. By the army law of Feb. 1, 1868, presented and carried by Niel, the time of military service was fixed at five years in the active army and four years in the reserve, and an active national guard was formed, in which all those who bought themselves off from military service, or who remained after the annual conscription (100,000 men) was filled, were compelled to serve. On paper the active army and the reserve amounted, according to this law, to 900,000 men, and the national guard, which was to be used for the defense of the frontier, to 550,000. But how small a part of this immense army was actually mobilized and fit for battle the year 1870 showed.

The attempts at inducing Prussia to yield and surrender territory were entirely frustrated by the proud but prudent stubbornness of Bismarck, who after 1866 began to show himself not as a Prussian minister, but as the Chancellor of the North German Confederation and a German patriot. In Aug., 1866, he declined an offensive and defensive alliance offered through Benedetti, which stipulated that Prussia should consent to the annexation of Luxembourg and Belgium to France, and France recognize the appropriations which Prussia had made and the intimate connection with Southern Germany which she wished to accomplish. During the following years he several times refused similar propositions which were made to him under different forms, and in the spring of 1867 he took so decidedly a national position in the Luxembourg question that France, not yet ready for war, was compelled to stop short of her demands. Napoleon having, May, 1867, appointed Gramont Minister of Foreign Affairs in the cabinet of Ollivier, from that moment the French policy assumed a more warlike course, especially influenced by the Empress Eugénie, who was entirely under the control of the Jesuits.

Soon after the question of the Spanish crown furnished the issue. On July 3, 1870, Marshal Prim, the president of the Spanish ministry, communicated to the court in Paris that Prince Leopold of Hohenzollern had declared himself willing to accept the royal crown of Spain, and the imperial government could not tolerate such a success of Bismarck's policy. On July 4 the French *chargé d'affaires*, Le Lourd, who represented the French Government at Berlin during the absence of the ambassador, Benedetti, appeared in the office of the foreign ministry of the North German Confederation and set forth the painful impression which the candidature of Prince Leopold had made in Paris. The Under-Secretary of State, Von Thiele, answered that the question did not at all concern the Prussian Government. The next day the Duke de Gramont declared in the Corps Législatif that no foreign power would be allowed to disturb the balance of the political system of Europe, and slight the interests and the honor of France, by placing one of its princes on the throne of Charles V. This declaration—which, however, was severely attacked by the opposition, especially by Emanuel Arago, Crémieux, Picard, and Jules Favre—produced great excitement in the whole nation, and attracted serious attention from all other powers. In Germany both the press and the people in general remained perfectly calm, partly because they confided fully in their own power and the wisdom of the Prussian Government, partly because they did not believe that the French really desired a war. The French Government, however, persevered in the course it had assumed. On July 9, Count Benedetti appeared before King William, who was at Ems, and proposed, in his peculiarly insinuating manner, that the king as chief of the house of Hohenzollern should command the prince to withdraw his acceptation of the Spanish crown. But King William, although unguided by his ministers, felt immediately the consequence of this seemingly unimportant question, and gave an answer which conformed to his dignity without offending France. He emphasized that he had given his consent to the prince's acceptance of the crown, not as King of Prussia, but as chief of the family, and he declined to recall the consent. On July 11 the French ambassador repeated his demand in a more impressive manner, even threatening Prussia with war, but he received the same answer from the king. Once more he returned to the same topic (July 13, in the morning), and when the king told him that the prince had renounced the Spanish crown on the previous day of his own free will, the ambassador asked him to declare publicly that he approved of the renunciation, and would not permit any resumption in the future of the candidature of the prince. Such a declaration—given, for instance, in the form of a letter to the Emperor Napoleon—would be necessary in order to still the excitement of the French people. This demand the king refused, and dispatched to Bismarck an account of what had been done. Bismarck, seeing it would be the best moment for wholly repudiating the French pretensions and beginning the war he held to be inevitable, published the facts, which roused the nation to a high pitch of excitement. Gramont, the French minister, laid a distorted representation of the previous negotiations before the Representative Assembly (July 15), alleging a gross affront offered to the French ambassador; and, although vehemently opposed by some members, especially by Thiers, the Assembly voted, nearly unanimously, 500,000,000 francs for the war. This was the actual declaration of war; the formal followed July 19.

Meanwhile the Government of the North German Confederation had taken the possibility of war under consideration. On July 11 a council of ministers was held at Berlin, presided over by the Minister of War. The question of taking some preparatory steps was debated, but, in full confidence of the perfect working capacity of the army organization, it was decided not to give any pretext for war by preliminary arming. The council knew that even if the South German states did not participate in the war, the North German Confederation could send to the frontier within two weeks an army of 511,826 men, with a reserve of 265,082 men in garrison and 180,672 men of the second call; thus placing a force of 975,256 men, including the staff, against the French army. Count Bismarck, who was on his estate at Varzin, repaired to Berlin on July 12, and the same day Gen. von Moltke arrived from Schweidnitz. On the 15th the king left Ems for Berlin, and on arriving at the Brandenburger station, where he was received by the Crown Prince, Bismarck, Moltke, and Roon, he heard of the vote of the Representative Assembly in Paris. He gave immediate orders for the mobilization of the whole army of the North German Confederation. The next day the Federal Council assembled, and the Parliament was called for July 19. In Southern Germany the French challenge produced, contrary to French expectations, the same outburst of patriotic enthusiasm as in the North. Louis II. of Bavaria took the lead in this national movement, and ordered the mobilization of his army (July 16). Baden, Hesse, and Würtemberg followed the example. The question hardly came up whether or not a *casus fœderis* existed; the South German states joined the North German Confederation by the force of a natural instinct.

The rash challenge of France had made the European nations believe that her army and navy were ready to strike a blow at the very first moment, yet France was slow and Germany quick. Moreover, the diplomatic actions of Bismarck contributed to a general neutrality and to sympathy with Germany. He made known to the world, through a notice in the London *Times* (July 25), and through a communication of July 28 to the German ambassador in London (Count Bernstorff), the proposition of common land-robbery which the French Government had made to him from time to time, and the denials of Benedetti and Gramont he disproved (Aug. 10) by communicating a letter of Aug. 6, 1866, from the former, containing a project of re-establishing the frontiers of France as they existed in 1814.

If Napoleon had ever had a plan of operations, he was soon compelled to give it up on account of the state of his army and the attitude of Southern Germany. It can not be doubted that even before the first battles were fought a complete lack of plan and decision reigned at the French headquarters. On July 14 the reserve was called in, but while the greatest exertions were made to collect a strong force on the German frontier, the bad organization of the army and the defective system of its mobilization caused an indescribable confusion in all military branches and on all the railways and at the stores of supplies. The whole force on the French side was ranged in the front line—that is, all the corps which were ready for battle at the end of July and in the beginning of August—numbered hardly more than 250,000 men. And this force, moreover, was dispersed in the following manner: First Corps, 37,440 men and 120 guns, under MacMahon, was at Strassburg; next to it was the Fifth Corps, 28,080 men and 90 guns, under De Failly, at Bitsch; to the left, opposite Saarbrücke, was the Second Corps, 28,080 men and 90 guns, under Frossard; the Third Corps, forming the reserve of the Second, 37,440 men and 120 guns, was at Metz, under Bazaine; and to the left of this, at Diedenhof (Thionville), was the Fourth, 28,080 men and 90 guns, under L'Admirault. The Sixth Corps, 37,440 men and 120 guns, under Canrobert, was concentrated at Châlons; the guard, 17,280 men and 72 guns, under Bourbaki, at Nancy; and the Seventh Corps, 27,360 men and 90 guns, under Douay, at Belfort. Napoleon later on asserted that this arrangement was based on the idea of forming a strong army at Strassburg to push rapidly forward toward the Main. Be this as it may, it is certain that the corps stood too far apart when the fight began to give each other sufficient support.

In Germany the state of affairs showed quite another aspect. Even the mobilization of the army exhibited a superiority which later on became evident also in its strategic and tactical management. It was decided, although an early French invasion was not anticipated, that all the different army-corps should be put in complete war-trim in their garrisons, while small bodies of troops should try, by clever operations on the frontier, to produce an impression of their being strong corps. The plan succeeded completely. The French were deceived with respect to the strength of the German garrisons along the frontier, and in the last week of July three powerful armies were formed, undisturbed, at Coblentz, Mentz, and Mannheim. The first army, under Gen. von Steinmetz, numbered 61,000 men and 180 guns. It formed the right wing, with Coblentz for its headquarters. The second army, under Prince Frederick Charles of Prussia, numbered 206,000 men with 534 guns. It formed the center, with its headquarters in Mentz. The third army, under the Crown Prince of Prussia, numbered 180,000 men with 480 guns, and formed the left wing. Thus the force of the first line amounted to 447,000 men and 1,194 guns. The commander-in-chief was King William of Prussia, and his chief of staff was Gen. von Moltke. In his suite were the chancellor, Count Bismarck, the Minister of War, Von Roon, and the quartermaster-general, Von Podbielski. The commander-in-chief of the French army was Napoleon III.

On July 30 the strategical evolution of the German army on the Rhine was finished, and the march toward the French frontier, which as yet the French had not crossed, began.

The firing between the French outposts and the German vanguard began Aug. 4 at Weissenburg, on the left wing, army of the Crown Prince, and the French were defeated, Gen. Douay himself being killed. As soon as the news of this defeat reached Marshal MacMahon he determined to throw immediately all disposable troops against the German, and he chose a position at Wörth, with 50,000 men. But on Aug. 6 the Crown Prince attacked and defeated him. The French lost 9,000 prisoners, 2 eagles, 6 mitrailleuses, and 35 guns, besides 6,000 wounded and dead.

The news that the flower of the French army, the African troops, under the best general, had been completely vanquished, filled all Germany with proud confidence, and destroyed every hope of alliance which Napoleon still might entertain. And the French were defeated on the same day not only on the right, but also on the left wing, at Saarbrück.

The defeat in the field caused an immense reaction politically. The empress issued a proclamation in which the defeat was acknowledged, and firmness and order were urgently entreated. The acting Minister of War presented a decree which asked for the enrollment of all active citizens between thirty and forty years of age in the stationary national guard, the employment of the national guard of Paris in the defense of the capital, and the enlistment of all citizens under thirty years of age into the active national guard. The official journal of the 8th gave a picture of the reigning despair; it besought all the peoples of Europe to stand by France. All unmarried men between twenty-five and thirty-five years of age, who before had been legally free of military service, and widowers without children, were now called in, unless already enrolled in the national guard. Companies of volunteers were also to be formed. The regency considered necessary even the measure of expelling all Germans living in France.

Meanwhile, the German armies streamed over the frontier into France, pursuing the advantages already gained. Wheeling around to the right, the first army proceeded very slowly, the third very rapidly. On Aug. 13 the royal headquarters were in the castle of Herny, 15 miles from Metz. It was believed that the French Rhine army would give battle at Metz on the 15th.

On the French side the greatest confusion prevailed. Bazaine became commander-in-chief instead of the emperor, Garras took the place of Le Bœuf as chief of staff. A council of war was held on the 13th, and determined that the army, which was encamped entirely on the right bank of the Moselle, and under the protection of the guns of Metz, should retreat on the next day to Verdun. Early on the 14th the retreat began. But as soon as the commander of the German outpost, Maj.-Gen. von Goltz, observed the enemy's movements in the afternoon, he advanced his brigade immediately and made an attack. A real battle developed—the battle at Courcelles. It was very bloody; the French lost about 4,000 men, the Germans about 5,000; but the latter were victorious, and pursued the enemy to the glacis of the fortress.

The next day gave the German army time to approach the enemy's line of retreat. Only the First Army-corps remained to watch Metz from the E.; the Seventh and Eighth were pushed near to the Moselle, S. of Metz, and the whole Second Army was to try to reach as rapidly as possible the road from Metz to Verdun. This operation was effected by Prince Frederick Charles. Bazaine had ordered that the retreat should begin on the morning of the 16th, and take place along both the roads leading to Verdun, and in the meanwhile Napoleon had left Metz under a strong escort. At 9.30 A. M. the French outposts noticed the approach of the enemy, and almost immediately after the German regiments of cavalry fell on the bivouacs of the French cavalry. A great battle developed—the battle of Vionville or Mars-la-Tour. It was the most bloody in the whole war. On the French side 120,000 men, on the German 60,000, were under fire. The loss on each side comprised about 16,000 men, dead and wounded. But it frustrated the intended retreat to Verdun, and compelled Bazaine to remain at Metz. On the 17th he went back and took up a defensive position. After ascertaining that the French had left their positions, the King of Prussia ordered a new attack on Aug. 18. It was intended that the right wing should engage the enemy first, then the center should attack, and at last the left wing was to strike a decisive blow by its pressure on the right flank of the French army. The decisive point of this battle (battle of Gravelotte or St.-Privat) was St.-Privat. Here the circuit of the Saxons forced the French to yield at 7 P. M. On the French left wing the battle lasted still longer; the victory was gained here by the arrival of the Second German Army-corps. The losses were very heavy. The French, numbering about 140,000 men, lost 609 officers and 11,605 men; the Germans, numbering 211,000 men, lost 904 officers and 19,658 men. The result of the battle was that the French army was shut up in the fortress of Metz. The German commander-in-chief ordered the investment of Metz, and disposed of the First and Second Army, under the command of Prince Frederick Charles, for this purpose. From this force, however, the Fourth and Twelfth Corps, the Guards, and the Fifth and Sixth Cavalry divisions were separated and formed into a Fourth Army, under the command of the Crown Prince of Saxony, who was now to push forward toward Paris, together with the Crown Prince of Prussia and the Third Army. On the French side the first plan was that the army of Châlons should retreat to Paris, but the regency feared that the return of Napoleon, who accompanied this army, would occasion a revolution in Paris; and it also hoped that MacMahon would be able to relieve Bazaine at Metz. For these reasons Count Palikao, now Minister of War, ordered Marshal MacMahon to break up at Châlons with his army, now numbering 140,000 men, and move northward in a circuit around the German army toward Metz. MacMahon broke camp at Reims on the 23d. On the 27th the outposts fell in with the vanguard of the German army, and a cavalry encounter ensued at Buzancy. On the 25th the movements of MacMahon were noticed by the Germans, and the Third and Fourth Armies, which were pushing forward to Paris, and then in the neighborhood of Châlons and Vitry-le-François, were immediately ordered to march to the right. On the 26th both armies wheeled around to the N., and followed MacMahon in forced marches in order to place themselves between him and Metz. They marched rapidly, while the French army had made only 60 miles in six days. On the 29th MacMahon removed his headquarters to Raucourt, and the army began to cross the Meuse at Mouzon.

Meanwhile, the two German armies, which were drawn nearer together, and already had adopted the plan of pressing MacMahon toward Belgium, came in contact with the right flank and front of the French, and by the encounters at Nouart and Beaumont on the 30th threw parts of the French vanguard back in confusion on the main body. On the 31st they advanced near to the army encamping around Sedan. The plan was to contract the curve still closer to the French army on Sept. 1, and to attack on the 2d. It was observed, however, that the French were in a wavering and uncertain condition, so that their crossing the Belgian frontier seemed by no means improbable; and for this reason the king ordered the attack on the army of MacMahon, which was very densely concentrated around Sedan, on the next morning. At the dawn of Sept. 1 the German army commenced its attack (Sedan), and soon it grappled the French army, which was concentrated on a narrow space, in shape like a pair of tongs. The battle began at Bazeilles, and drew E. of Sedan farther and farther to the N.; in the beginning of the battle the French army had lost its commander-in-chief. MacMahon, severely wounded by a splint from a shell, gave up the command to Gen. Ducrot, from whom Wimpffen reclaimed it as the senior officer. Thus the command and the plan changed several times. It was the idea to break through the German lines somewhere, in order to afford an escape for the emperor, and he himself sought for a long time on the battlefield for such an opportunity; but the undertaking was evidently hopeless, and the army, as well as its leader, had to submit to its frightful fate. Shortly after 3 P. M. offers to conclude a capitulation were made from the French side. Napoleon sent the following letter to the king: "As I have not fallen at the head of my soldiers, I surrender my sword to Your Majesty." When this letter was brought to the king by Gen. Reille, adjutant-general to the emperor, the king demanded the capitulation of the French army as the first condition, and declared that he then would accept the imperial sword, and charged the chancellor and his chief of staff with the necessary diplomatic and military negotiations.

In the forenoon of Sept. 22 Gen. Wimpffen concluded the capitulation of Sedan, by which 84,433 men, 39 generals, 230 officers of the staff, and 2,095 subaltern officers were surrendered into German captivity. After the conclusion of the capitulation the king and the captive emperor had a conversation of a quarter of an hour at the palace of Bellevue. Napoleon went through Belgium to the palace of Wilhelmshöhe at Cassel, which was designated as a residence for him, and the French army was sent to Coblentz, Mentz, and other German fortresses.

The news of the catastrophe, which arrived at Paris on Sept. 4, caused an immense commotion. Jules Favre and his friends assailed the regency in the Corps Législatif, and demanded the deposition of the emperor. The turbulent elements of Paris filled the streets with tumult and thronged into the hall of the Corps Législatif, which assembly they dispersed. The members of the opposition then assembled at the Hôtel de Ville and formed a provisional government of national defense. Gen. Trochu, who had been governor of Paris since Aug. 17, was elected president; Jules Favre, vice-president; Ferry, secretary. This government determined immediately on the abolition of the senate and the Corps Législatif. At 1 P. M. the empress left the Tuileries and fled to England.

Considering the capture of Paris as the most important task of the war, immediately after the capitulation of Sedan the victorious armies began to move toward the capital, and on Sept. 19 the investment of the city was complete. But the strength of the besieging army was only 122,000 infantry and 24,000 cavalry, with 622 cannon, while the army in Paris had a strength of about 400,000 men including the national guard; moreover, Paris had sixteen strong forts.

The war continued at many points—in the Vosges, at Strassburg, at Besançon, at Metz, on the Loire. Strassburg fell Sept. 27 into German hands; Metz capitulated Oct. 27 with an army of 180,000 men, who were conducted as prisoners to Germany. On the Loire Gen. d'Aurelle de Paladines with 70,000 men moved toward Paris for help, but encountered at Orleans a German army under Prince Frederick Charles, and was repulsed in November. In vain Gen. Trochu with the army of Paris made vigorous rallies in November and December; he could not break the German war-chain. In December Prince Frederick Charles defeated completely the Loire army, now under Gen. Chanzy. But in the north a French army had been created, under command of Gen. Faidherbe, and was directed to the support of besieged Paris. Gen. von Manteuffel marched against that force with 40,000 men, and defeated it on Nov. 27 at Quesnel and Mézières, again in December at St.-Quentin, and on the river Hallue, and took Rouen and Amiens. German troops reached the coast of the Atlantic. A German army under Gen. von Werder defeated the French finally on the river Lisaine, and at the same time Prince Frederick Charles defeated the last French forces in the east at Le Mans.

Now, finally, all French armies in the provinces having been defeated, the fate of Paris was soon decided. The negotiations concerning an armistice took place between Count Bismarck and Minister Favre, and Jan. 28, 1871, the armistice was concluded. An agreement was arrived at that hostilities should cease and the provisioning of Paris immediately begin. Indeed, there was great danger that a part of the population might be starved to death. A convention was concluded containing an armistice of twenty-one days and the capitulation of Paris. The armistice was considered as preliminary to peace; its purpose was the convocation of a French national assembly.

The National Assembly met at Bordeaux Feb. 12, 1871. It had to decide whether peace should be concluded or whether the war should be continued. Further resistance, however, seemed a complete impossibility. France was utterly exhausted and completely defeated; her long and desperate resistance, possible only on account of the heroism of the population, had increased her loss; 400,000 French soldiers, among whom were 11,860 officers, were in captivity; about 100,000 men were disarmed in Switzerland, and the army of Paris would, according to the convention, also have to go to Germany as prisoners of war if hostilities were recommenced. Furthermore, the active troops were in a miserable state. Not only all the officers, but also all the trained soldiers, had either become prisoners by the great capitulations of Sedan and Metz, or they were wounded or dead. The active troops consisted of recruits led by a few generals. Not only in quality, but also in number, they were inferior to their adversaries. On Mar. 1, 1871, the Germans had on French soil 569,875 infantry and 63,465 cavalry, with 1,742 guns, and in Germany was an army of 250,000 men under arms. The eight French corps numbered not more than 250,000 men. An immense quantity of war-material had fallen into German hands—1,835 field-pieces, 5,373 heavy guns, and over 600,000 small-arms. Furthermore, all important strategical points were in the possession of the German army, and it held Paris in its hands. Under such circumstances all parties in the National Assembly, with very few exceptions, agreed that peace was necessary. On Feb. 13 the provisional government of national defense transferred its power to the Assembly; and on Feb. 17 the chief of the executive power of the French republic, the former minister of Louis Philippe, Adolphe Thiers, was sent to the German headquarters at Versailles, where King William of Prussia, who had been crowned Emperor of Germany, had resided since Jan. 18, to negotiate for peace. On Feb. 21 Thiers arrived, accompanied by a diplomatic committee. The armistice was prolonged to Feb. 26. The demands of the German Government were very heavy; the cession of Alsace and Lorraine, with Metz, Strassburg, and Belfort, and the payment of six milliards, were demanded. By their stubborn perseverance and by the support of the British Government the French negotiators succeeded in securing Belfort as a French possession and in getting the war expenses decreased by one milliard. On Feb. 26 the preliminary peace of Versailles was signed; Alsace and the largest part of Lorraine were ceded; five milliards were to be paid as war expenses; and German garrisons were to remain on French soil until full payment was made. Concerning the payment and the occupation, it was specially stipulated that one milliard should be paid in the course of the year 1871, and the rest in three years. The German troops should evacuate the city of Paris and the forts on the left bank of the Seine immediately after the ratification of the preliminary peace, and as soon as possible the departments Calvados, Orne, Sarthe, Eure-et-Loir, Loiret, Loir-et-Cher, Indre-et-Loire, and Yonne completely, and the departments Seine-Inférieure, Eure, Seine-et-Oise, Seine-et-Marne, Aube, and Côte-d'Or to the left bank of the Seine. After the ratification of the definitive peace and the payment of half a milliard the departments between the right bank of the Seine and the eastern frontier should be evacuated, and after the payment of two milliards only the departments Marne, Ardennes, Haute-Marne, Meuse, Vosges, Meurthe, and the fortress of Belfort, with its surroundings, should be occupied. An interest of 5 per cent. should be paid on the three milliards whose definitive payment was postponed. The preliminary peace also contained stipulations concerning the delivery of the prisoners of war and the government of the occupied French districts. This agreement was laid before the National Assembly by Thiers on Feb. 28, 1871, and accepted by 546 votes against 107 on Mar. 1. On the same day a part of Paris was occupied by 30,000 German troops. On Mar. 3 the ratifications of the preliminary peace were exchanged at Versailles, Paris was evacuated, and the removal of the German army to the right bank of the Seine was ordered. Mar. 13 the German emperor left Versailles for Berlin. May 10, 1871, the definitive treaty of peace was concluded at Frankfort-on-the-Main, and on account of the rapid payment of the war expenses the last German soldier left French soil in July, 1873. See O'Shea, *An Iron-bound City* (London, 1886); Franklyn, *The Great Battles of 1870 and Blockade of Metz* (London, 1887); Brockett, *The Year of Battles* (1871); Steenackers and Goff, *Histoire du Gouvernement de la Défense Nationale en Province* (Paris, 1884); Maurer, *Deutsch-französische Krieg 1870–71* (Leipzig, 1889); Scherr, *1870–1871* (Leipzig, 1880); Moltke, *Geschichte des deutsch-französischen Krieges von 1870–71* (Berlin, 1891; Eng. trans. *The Franco-German War*, New York, 1892).

Revised by C. K. Adams.

Francolin [Fr.: Ital. *francolino*: Span. *francolin*, from Portug. *francolim*, apparently a Latinized diminutive of Portug. *frango*, cock]: a partridge-like bird of the genus *Francolinus*, or some allied genus. The francolins have rather long bills and tails, and generally a rich, variegated plumage. Thirty or more species are known, all confined to the Old World and most abundant in Africa. They are good game birds, lying well to dogs and flying swiftly and steadily. The common francolin (*Francolinus vulgaris*), once common in Southern Europe, is now extinct there, although common in Cyprus, Asia Minor, and other parts of Asia. F. A. LUCAS.

Franco'nia [Mod. Lat. from Germ. *Franken*, Franconia]: an old independent territory situated along the Rhine, the Neckar, and the Main, from whose dukes the German empire more than once elected its rulers. It underwent many changes and modifications until, at the dissolution of the German empire in 1806, it was divided between Bavaria, Saxony, Hesse, and Baden.

Franconia Mountains: the western cluster of the White Mountain group; in Grafton co., N. H.; separated from the main group by the Notch. The Franconia Mountains are not as high as the others, but the presence of little lakes adds a charm to the scenery. Mt. La Fayette, or the Great Haystack, is 5,296 feet high. Echo Lake, Eagle Cliff, the Profile Rock, Profile Lake, Bald Mountain, Walker's Falls, the Basin, the Flume, the Pool, and Georgiana Falls are attractive points. The mountains have deposits of iron ore.

Francs Tireurs, fraañk'tēē'rėr' [Fr., free marksmen; *francs*, plur. of *franc*, free + *tireurs*, plur. of *tireur*, deriv. of *tirer*, draw, shoot, fire]: a name applied during the Franco-German war to the members of the French guerrilla parties who carried on an annoying partisan warfare against the Germans.

Franeker, fraa'ne-ker: town of the Netherlands; province of Friesland; 9 miles by rail W. of Leeuwarden (see map of Holland and Belgium, ref. 2–G). Its university was founded in 1585, abolished by Napoleon in 1811, and in 1816 transformed into an athenæum. It was a very celebrated institution in the days of Vitringa, Hemsterhuis, and Valckenaer. The town possesses the planetarium made by Eise Eisinga, one of its citizens, in the years 1773–80. Pop. (1890) 7,198.

Frangipani, fraan-jee-paa'nēē: a once illustrious family of Rome, having also allied lines of the same name in Naples and Croatia. The family is traced as far back as the seventh century, and even claims to date from pagan Rome. During the eleventh, twelfth, and thirteenth centuries the name, already illustrious, became one of the most splendid in Italian annals, but rapidly declined thereafter. The name, it is claimed, signifies the "bread-breakers," from the charities of its founders.—Among its prominent members were CENCIO, a Ghibelline of the twelfth century; GIOVANNI, in the thirteenth century, a soldier and founder of the Neapolitan line; CORNELIO (d. 581), a great Friulian advocate, living at Venice; CLAUDIO CORNELIO, his son (1533–1630); NICCOLÒ, a Venetian painter of the sixteenth century; FRANZ CHRISTOPH, a Croatian conspirator (1630–71).

Frank, FRANZ HERMANN REINHOLD, D. D.: Lutheran theologian; b. in Altenburg, Germany, Mar. 25, 1827; studied at Leipzig; became professor at Erlangen 1857. Author of *Die Theologie der Konkordienformel* (4 vols., Erlangen, 1858–65); *System der christlichen Gewissheit* (3 vols., 1870–73, a treatise on apologetics, making regeneration the condition of certainty; translated into English, *System of Christian Certainty*, Edinburgh, 1886); *System der christlichen Wahrheit* (2 vols., 1878–80; 2d ed. 1885–86; a treatise on dogmatics, defending conservative Lutheranism according to modern philosophical methods); *System der christlichen Sittlichkeit* (1884–87, 2 parts; a treatise on ethics); *Vademecum für Angehende Theologen* (Leipzig, 1892). Among other numerous writings is a minute examination of the theology of Ritschl (1888; 3d ed. 1891).

Frank, JACOB, properly *Jankiew Lebowicz*: Jewish adventurer; b. in Southern Galicia, Poland, 1712. His father was a rabbi; he himself joined the sect of the Cabbalists, but started a movement of his own, proclaiming himself the promised Messiah, and attracted many followers. In 1756 the sect came under the ban of the synagogue for alleged immoralities. He then professed Christianity, and with 1,000 followers was baptized. Reviving his old pretensions he made his headquarters in Warsaw, gave himself out as Christ, and chose twelve apostles. This conduct brought him into trouble, and he was imprisoned from 1760 to 1763. His followers remained faithful, and he removed to Brünn, in Moravia, where he lived in princely style until 1786, when he was driven out. He then went to Offenbach, in Hesse, kept up the same mode of life, and there died Dec. 10, 1791. See H. Grätz, *Frank und die Frankisten* (Breslau, 1868).

Frankalmoign, frăngk-ăl-moin' [from Anglo-Fr. *franc almoigne* (= O. Fr. *franc almosne*), free alms]: in English law, the tenure, chiefly of lands, by spiritual service, as where a sole or aggregate corporation holds an estate of some private person, who gives it to God as free and perpetual alms. Tenures by frankalmoign were forbidden to be created after the eighteenth year of Edward I., but there are in England many examples dating from before that time, now chiefly ecclesiastical foundations or parish glebes. Frankalmoign implied no fealty or service, as did some other similar tenures.

Frankenthal, fraan'ken-taal: town of Bavaria; in the Palatinate; 7 miles by rail S. W. of Worms (see map of German Empire, ref. 6–D). A canal 60 feet wide and 3½ miles long puts it in communication with the Rhine. It has a bell-foundry, machine-shops, important sugar-refineries, and a large trade in lumber, iron, and wine. Frankenthal appears in the eighth century as the village of Franconodal. It suffered in the Thirty Years' war, and in 1688 was captured by the French, who burned it Sept. 13, 1689. Pop. (1890) 13,008.

Frankford: a former borough, now part of Philadelphia, Pa., in the northeast part of the city; separated from the main portion of the city by Tacony Creek. It has a celebrated asylum for the insane and important manufactures. See PHILADELPHIA.

Frankfort: city and railway center; capital of Clinton co., Ind. (for location of county, see map of Indiana, ref. 5–D); 46 miles N. W. of Indianapolis; in a fertile agricultural region. It has railway car-shops and is supplied with natural gas. Pop. (1880) 2,803; (1890) 5,919; (1900) 7,100.

Frankfort: city; Marshall co., Kan. (for location of county, see map of Kansas, ref. 4–H); on Mo. Pac. R. R., and on Vermilion river; 78 miles W. of Atchison. It is situated in a grain-producing region and has good water-power. Pop. (1890) 1,053; (1900) 1,167.

Frankfort: city; capital of Kentucky and of Franklin County (for location of county, see map of Kentucky, ref. 3–H); situated in a group of hills on both sides of the Kentucky river, and on the Louisville and Nashville and the Kentucky Midland Railways; 65 miles by rail E. of Louisville. It

State Capitol, Frankfort, Ky.

is noted for the picturesqueness of its scenery and the fine drives in the vicinity. It contains a fine public-school building, a high school, a seminary for young ladies, an institution for the training of feeble-minded children, gas and water works, manufactures of lumber, carriages, furniture, and twine, a cotton-mill, a barrel-manufactory, a pottery, flouring-mills, several distilleries, and the State prison. The Capital Hotel, of stone, was erected at a cost of $120,000. The Frankfort Cemetery is very beautiful, and in it repose the remains of many of Kentucky's great and gallant men. Nearly all the various benevolent orders have lodges in the city, and the Odd Fellows own a handsome temple. Pop. (1880) 6,958; (1890) 7,892; (1900) 9,487.

Frankfort: village; Benzie co., Mich. (for location of county, see map of Michigan, ref. 5–H); on the east shore of Lake Michigan; 40 miles N. of Manistee. It is a terminus of the T., A. A. and N. M. Railway, which connects with the G. B., W. and St. P. Railroad at Kewaunee, Wis., by a commodious car-ferry. The village is situated in a great fruit-growing district, and has 3 churches, a fine school, 2 foundries, a planing-mill, 3 sawmills, a shingle-mill, mineral springs, and one of the finest harbors on Lake Michigan. Pop. (1880) 782; (1890) 1,175; (1900) 1,465.

EDITOR OF "EXPRESS."

Frankfort, Council of: a synod noted in church history for its condemnation of Adoptianism, the heresy which asserted that Christ was the Son of God as to his human nature only by *adoption* (see ADOPTIAN CONTROVERSY); and its decided action against the worship of images. It was called by Charlemagne A. D. 794, and, according to Dupin (*Eccles. Hist.*, cent. viii.), was attended by 300 bishops, who came from Germany, Gaul, Spain, Italy, and England, besides two delegates from the pope. See Hefele, *Conciliengeschichte*, iii., 635, *seq.*; Landon, *Manual of Councils*, s. v.; and J. I. Mombert, *Charles the Great*, pp. 327–334.

Frankfort-on-the-Main [Germ. *Frankfurt-am-Main. Frankfurt* is from Germ. *Franke*, Frank + *furt*, ford]: city of Prussia; province of Hesse-Nassau; situated on the right bank of the Main, and connected with the suburb Sachsenhausen, on the opposite bank, by seven bridges, the oldest of which, a stone bridge of fourteen arches, was built in 1340 (see map of German Empire, ref. 5–D). The city proper is as beautiful as it is interesting. It is entered by seven large gates, two of which, the Gallus Thor and the Eschenheimer Thor, have been preserved in their old form; the other five are buildings of modern style. But the walls and the ditches which formerly stretched between these gates have been transformed into charming promenades, where splendid villas and resorts of amusement alternate with almost rural surroundings. Among its public squares are the Rossmarkt, with the monument of Gutenberg, designed by Launitz, and the Götheplatz, with the statue of Goethe by Schwanthaler. Among its public buildings the most remarkable are the Römer, or town-hall, an old building, in whose *Wahlzimmer* the electors met, and in whose *Kaisersaal* the elected emperor gave his first banquet; and the Cathedral of St. Bartholomew, a Gothic structure begun in 1238 and finished in the sixteenth century, in which the coronation of the German emperors took place. The city is well provided with educational and charitable institutions, contains a fine zoölogical garden, and has manufactures of sewing-machines, perfumery, chemicals, straw hats, etc., extensive banking-houses, and important commercial interests. Leipzig has superseded it in the book-trade, but as a moneyed center it still occupies the principal place. It is the richest city of its size in the world and the banking-house of Germany.

On account of its geographical position, Frankfort early attracted attention. It was a favorite residence of Charlemagne. In 1257 it was made a free city. After the days of Frederic Barbarossa it became the place for the election of the German emperors, and by the "Golden Bull" (in 1356) Charles IV. transformed this custom into a right. Napoleon made it the capital of a great principality. In 1848 and 1849 the German Parliament sat here; but the city sided with Austria in the war of 1866, and consequently lost her autonomy in that year. Pop. (1900) 288,489.

Frankfort-on-the-Oder: city of Prussia; province of Brandenburg; on the Oder; 50 miles E. by S. of Berlin (see map of German Empire, ref. 4–H). It has extensive tanneries, machine-shops, foundries, manufactures of organs, sugar, starch, tobacco, cigars, paper, wooden-ware, and chemicals, and an extensive trade. Its three annual fairs have more than 10,000 visitors, especially dealers from Poland. Its university, which was founded in 1506 by the elector Joachim I., was moved to Breslau in 1811. The city was a flourishing member of the Hanseatic League; it has several times suffered severely in war. Pop. (1895) 59,161.

Frank'incense [M. Eng. *frankincens*, *franc encens*, from O. Fr. *franc encens*, free or pure incense]: any one of various fragrant gums and resins. It anciently designated the substance now known in commerce as OLIBANUM (*q. v.*), the product of a couple of African and East Indian species of *Boswellia*, small trees of the family *Burseraceæ*. The frankincense of Sierra Leone is from the *Daniella thurifera* (family *Leguminosæ*), a large mountain-tree of that region. In the United Kingdom the frankincense of the shops is nothing but common turpentine, such as is exported from the Southern U. S.

Franking Privilege [deriv. of *frank*, free; Fr. *franc*]: the right of sending letters or packages free by mail. The post-office having been originally established solely for governmental purposes, the carriage of official correspondence remained for a long time its only business. The grant to the University of Paris and the well-known concessions of the German princes to the Counts of Thurn and Taxis having placed the post in the position of a carrier for hire, free correspondence between officers of the Government and other favored persons came gradually to be regarded in the modern light of a privilege. In England the right was claimed by the House of Commons in 1660, and privately allowed to members by the crown, which had hitherto enjoyed it in connection with the entire control and revenues of the post-office. In 1839 the privilege was abolished in Great Britain by the passage of Rowland Hill's act.

In the U. S. the first appearance of the franking privilege after the assumption of the post-office by the Continental Congress was in Jan., 1776, when it was granted to all private soldiers actually in service for letters written by and to themselves. Every few years since then Congress has modified the laws governing the privilege as the increase of public business or the prevention of the improper use of the privilege required. Ordinances conferred the privilege on specified officers while in public service; others restricted or extended the privilege; public documents from every department of the Government were made subject to free carriage; newspapers were allowed free exchange with each other; the privilege was extended by special acts to ex-Presidents and their widows during life; and then these general provisions were more or less modified, and some of them abolished. The act of Mar. 3, 1845, limited the privilege to the President, Vice-President, members and delegates in Congress, the third assistant Postmaster-General, and postmasters; other officers being directed to keep quarterly accounts of postage, and to pay it from their respective contingent funds. This act was soon amended, the provision requiring accounts to be kept of official postage was repealed, and an appropriation of $200,000 for official postage made, and subsequently increased to $500,000. The free exchange of newspapers was re-established in 1851.

By the act of Mar. 3, 1863, the privilege was conferred upon and limited to the following persons and articles: the President and his private secretary; the Vice-President; chiefs of executive departments; such heads of bureaus and chief clerks as might be designated by the Postmaster-General, for official letters only; Senators and Representatives in Congress for all correspondence, documents printed by authority of Congress, speeches and proceedings therein, and printed matter addressed to them, said privilege to commence with their term of office and to continue until the first Monday in December after its close; to all Government officers for letters indorsed official and addressed to the heads of their respective departments; to postmasters for indorsed official correspondence with each other, a penalty of $300 being provided for false indorsement; to publishers of newspapers for their exchanges; and to senders of petitions to either branch of Congress. The weight of the above-named articles, excepting petitions and public documents, was limited to 4 oz. Members of Congress were also authorized to frank "seeds, roots, cuttings, and scions," the weight to be fixed by the Postmaster-General. With very slight modification this law remained in force until Jan. 31, 1873, when an act was passed abolishing the franking privilege, and declaring that thenceforth all official correspondence should be chargeable with the legal rates of postage. At the same session all laws for the transmission of free matter were repealed, and an appropriation of $1,865,900 was made for the purchase of special stamps for the use of the chief executive, heads of departments, secretary of the Senate, and the clerk and sergeant-at-arms of the House.

By act of June 23, 1874, public documents, certified as such by the signature of any member of Congress or head of department, were allowed to go through the mails at a postage of ten cents, and the *Congressional Record* for one cent; and by act of Mar. 3, 1875, the franking privilege was restored to members of the existing Congress for such documents then printed or ordered to be printed, for the *Congressional Record* or parts thereof, and for seeds from and reports of the Agricultural Department, which latter were also authorized to be sent free by the Commissioner of Agriculture. By the act of Feb. 27, 1877, special stamps or stamped envelopes for official letters were required to be prepared by the Postmaster-General and sold to the executive departments. The act of Mar. 3, 1877, abolished the use of official stamps, and provided official envelopes for the departments, with a penalty of $300 on their use for private matter, and authorized all public documents to be transmitted free by Senators and Representatives, the secretary of the Senate, and the clerk of the House. The use of the "penalty-envelopes" was by act of Mar. 3, 1879, extended to all officers of the Government except pension-agents, and to the Smithsonian

Institution. Official postage-stamps were again introduced for the State, War, Navy, Treasury, and Interior Departments and for the Attorney-General by acts of Mar. 3, 1881, Aug. 5, 1882, and Mar. 3, 1883. The latter act directs the departments to inclose penalty-envelopes in official communications to members of Congress requiring to be answered or forwarded. By act of Dec. 20, 1881, the franking privilege was granted to the widow of President Garfield. The act of Congress approved Mar. 3, 1891, extended the franking privilege by providing that "the members and members-elect of Congress shall have the privilege of sending free through the mails, and under their frank, letters to any officer of the Government, when addressed officially."

Frankish Language: See DUTCH LANGUAGE.

Franklin: city and railway junction; capital of Johnson co., Ind. (for location of county, see map of Indiana (ref. 7–E); in an agricultural district, 27 miles E. of Martinsville. It has a college, a high school with a $55,000 school-building, gas-works, planing-mills, flouring-mills, and sawmills. Pop. (1880) 3,116; (1890) 3,781; (1900) 4,005.

Franklin: town; capital of Simpson co., Ky. (for location of county, see map of Kentucky, ref. 5–F); on the L. and N. Railroad; 134 miles S. of Louisville, Ky., and 51 N. of Nashville, Tenn. It has two colleges (for males and females respectively), a woolen-factory, and two flour-mills. Pop. (1880) 1,686; (1890) 2,324; (1900) 2,166.

Franklin: town; capital of St. Mary parish, La. (for location of parish, see map of Louisiana, ref. 11–D); on railway and on Bayou Têche; 30 miles W. of Morgan City: in a region devoted to raising sugar-cane. Pop. (1880) 1,702; (1890) 2,127; (1900) 2,692.

Franklin: town and railway junction; Norfolk co., Mass. (for location, see map of Massachusetts, ref. 5–I); on New Eng. R. R., 27 miles S. W. of Boston. It is the seat of Dean Academy, and has six churches, a public library, manufactures of pianos, and straw, woolen, and cotton goods, an iron foundry, canning factory, etc. Pop. of township (1880) 4,051; (1890) 4,831; (1900) 5,017.

EDITOR OF "SENTINEL."

Franklin: city; on railway; Merrimack co., N. H. (for location of county, see map of New Hampshire, ref. 8–F); at the junction of the Pemigewasset and Winnipiseogee rivers, which form the Merrimack; 18 miles N. by W. of Concord. Franklin Falls is another village in the same township, on the Winnipiseogee river, E. of Franklin proper. The two together have six churches, large paper and pulp mills, machine-shops, wood-working shops, manufactures of hosiery and knitting-machines, several woolen-mills, and one of the largest needle-factories in the world. The New Hampshire Orphans' Home is in the township, 3 miles S. of Franklin, on the farm once owned by Daniel Webster. Pop. of township (1880) 3,265; (1890) 4,085; (1900) 5,846.

EDITOR OF "MERRIMACK JOURNAL."

Franklin: village (founded by Gen. William Schenck in 1796); Warren co., O. (for location of county, see map of Ohio, ref. 6–C); on two railways; on the Great Miami river and on the Miami and Erie Canal; 40 miles by rail N. N. E. of Cincinnati. It has 6 churches, 2 schools (one a high school), a large paper-stock assorting establishment, 5 paper-mills (with nine machines), 2 wood-pulp mills, and 3 large tobacco warehouses. Pop. (1880) 2,385; (1890) 2,729; (1900) 2,724.

EDITORS OF "CHRONICLE."

Franklin: city and railway center (incorporated in 1868); capital of Venango co., Pa. (for location of county, see map of Pennsylvania, ref. 3–B); on the Allegheny river at the mouth of French creek. It contains flouring-mills, machine-shops, planing-mills, carriage-factories, lubricating-oil refineries, illuminating-oil refineries, etc.; and its streets are provided with sewers and paved with brick. Pop. (1880) 5,010; (1890) 6,221; (1900) 7,317.

EDITOR OF "CITIZEN-PRESS."

Franklin: town; capital of Williamson co., Tenn. (for location of county, see map of Tennessee, ref. 6–E); on railway and on Harpeth river; 18 miles S. of Nashville. It has a Masonic temple, flouring-mills, a furniture-factory and planing-mill, steam cotton-gins, carriage-manufactories, etc. It is the seat of Tennessee Female College, a prosperous institution, of Harpeth Male Academy, and of other schools, some of them free. Here Gen. Van Dorn was repulsed by Gen. Granger, Apr. 10, 1863, and here, Nov. 30, 1864, a bloody battle was fought between the forces of Gen. Hood and those of Gen. Schofield. (See FRANKLIN, BATTLE OF.) Pop. (1880) 1,632; (1890) 2,250; (1900) 2,180.

Franklin, Battle of: a battle of the U. S. civil war between the Confederates under Gen. Hood and the Union forces under Gen. Schofield. After the fall of Atlanta (Sept. 2, 1864), the Confederate authorities, aware of the necessity of drawing or forcing Sherman from Georgia, determined upon an invasion of Tennessee, and on Oct. 1 Hood crossed the Chattahoochee with 40,000 men to destroy Sherman's communications. Sherman, becoming aware of this intention, severed his communications and proceeded on his famous "march to the sea." After Sherman's departure Gen. Hood continued his movement toward Nashville, frequently engaging the Union troops, under Schofield, who continued to fall back before Hood's advance, until, arriving at Franklin, Tenn. (Nov. 30), Hood followed in such close pursuit that Schofield was compelled to give battle there. Gen. Schofield's object was to get his trains across the river and away to Nashville; Hood's object was to attack before he could do so. Schofield disposed his cavalry along the north bank above and below the town to guard the fords; on the heights of this bank a part of his artillery was also placed, and one division of infantry, to cover the crossing and support the cavalry and artillery. His army numbered about 27,000 men. Four divisions were posted on the south side of the river, Wagner with two brigades occupying an advanced position. Hastily constructed breastworks were thrown up along the main line, reaching from river to river, behind which artillery was well posted. At 4 P. M. Hood attacked Wagner in his advanced position; the latter, maintaining the defense too long, was driven back in confusion, with a loss of 1,000 men, into and through the center of the main lines. Continuing the attack Hood's men penetrated within the broken Union lines, capturing eight guns. At this critical moment Col. E. Opdycke (125th Ohio), commanding the brigade of Wagner's division which had been left within the main lines without waiting for instructions led his brigade into the gap, forcing back the Confederates and recapturing the guns. Of this exploit, Gen. Thomas reported that "it saved the army from destructive defeat." Continued assaults were made by the Confederates, the battle lasting till a late hour, but each time they were repulsed with great loss. At midnight Schofield withdrew his troops and train to Nashville, suffering little molestation. The total Confederate force engaged was about 55,000 men; their losses in killed, wounded, and missing, about 7,000, including 12 general officers. The Union losses, in killed, wounded, and missing, were about 3,000, of which 1,000 were in Wagner's division.

Revised by JAMES MERCUR.

Franklin, BENJAMIN, LL. D., F. R. S.: statesman and philosopher; b. in Boston, Mass., Jan. 17, 1706. His father, Josiah Franklin, was a tallow-chandler, and was of English birth, belonging to a Northamptonshire family; his mother, the daughter of Peter Folger of Nantucket. Benjamin was the fifteenth of seventeen children. To keep him from going to sea, he was apprenticed to his brother James, a printer, and by much reading, careful and assiduous writing (as much as possible after the style of the *Spectator*), together with the unassisted study of mathematics, he acquired such knowledge and facility in writing that he ventured to print his thoughts upon public affairs in his brother's newspaper, the *New England Courant*. His papers were well received by the public, but the discovery of their authorship led to a quarrel between the brothers. The newspaper was for a time published in Benjamin's name during an imprisonment of James, to which he was subjected for political reasons. In 1723 the young apprentice, wearying of the tyranny he experienced, broke his indentures and ran away, first to New York and thence to Philadelphia, where he found employment as a journeyman printer. He was in England 1725–26, having been sent by Sir William Keith, the Governor, who promised to set him up in business as the public printer of Philadelphia, but failed to keep his promise. After his return to Philadelphia he married (1730), established the *Pennsylvania Gazette*, and soon found himself a person of the first consideration, not only in Philadelphia, but throughout the provinces, for his talents as a writer and his sound judgment in public and business affairs. He established the Philadelphia Library in 1742, and the American Philosophical Society in 1744; was prominent in founding a college which in 1753 became the University of Pennsylvania; carried on his famous investigations into the nature of lightning 1746–52, and still later resumed them; and for his papers on the subject he received the Copley gold medal and was elected F. R. S. in 1775. In 1753 he was made Postmaster-General for the colonies, and several times served efficiently as commissioner to the mother-country and to the various colonies. From St. Andrews, Oxford, and Edinburgh in 1764 he received the degree of LL. D. In 1754 he proposed a plan for uniting the thirteen colonies under a central government, under which each colony might preserve its local independence. He did his best to prevent the Revolutionary war by trying to avert the injustice which caused it; procured the repeal of the Stamp Act 1766; and ever warmly sustained the colonial rights, though by a considerable party his patriotism was somewhat later sharply questioned. In 1775 he was chosen to the Congress, and in 1776 he was one of the signers of the Declaration of Independence, having been also one of the committee to draft that instrument. He was (1776–85) employed in the diplomatic service of the U. S., chiefly at Paris, where his influence in behalf of his country was powerful and serviceable in the highest degree, and where his simplicity, dignity, and wisdom made him highly popular. He was president of the Pennsylvania supreme council (in effect Governor of the State) 1785–88. In 1787 he was one of the delegates to the convention which drew up the U. S. Constitution. D. at Philadelphia, Apr. 17, 1790.

Of the writings of Franklin, the *Busybody*, a series of admirable papers somewhat after the manner of the *Spectator*, but far more readable, and the incomplete *Autobiography*, are the best known, but his political, anti-slavery, financial, economic, and scientific papers are all noteworthy. He published the famous *Poor Richard's Almanac* (1732–57), which was extensively reprinted in Great Britain. In youth he was an avowed skeptic in religious matters, and of somewhat loose morals, but his practical good sense enabled him to correct his way of living, and he in later life treated the Christian religion with reverence, though never avowing his faith in any religious system. His wife bore him two children: a son who died in his youth, and a daughter who became Mrs. Bache.—His son WILLIAM (1729–1813) was illegitimate; was royal Governor of New Jersey (1762–76; but became a royalist, went to England, and died there.—His grandson WILLIAM TEMPLE FRANKLIN (1760–1823) was his grandfather's secretary in Paris and the editor of his writings. See Lord Jeffrey's articles, *Edinburgh Review*, July, 1806; Aug., 1817; Bancroft's *History of the United States*, vol. ix., ch. xxix.; A. Norton's article in *The North American Review*, vol. vii.; Condorcet, *Éloge de Franklin* (1790); Mignet, *Vie de Franklin*; Bauer, *Washington und Franklin* (Berlin, 1803–06); C. Schmaltz, *Leben Benj. Franklins* (1840). In 1868 a corrected edition of Franklin's *Autobiography* was published by John Bigelow, from MSS. found in Paris. See also Brougham's *Statesmen of the Time of George III.*, vol. ii.; Parton's *Life and Times of B. Franklin* (1864); Hale's *Franklin in France* (1887): Theodore Parker's *Historic Americans* (1870); and *Franklin's Works*, edited by John Bigelow (10 vols.). Revised by C. K. ADAMS.

Franklin, Sir JOHN, D. C. L., F. R. S.: rear-admiral; b. at Spilsby, Lincolnshire, England, Apr. 16, 1786; went to sea in childhood; entered the navy; served at Copenhagen, Trafalgar, and New Orleans (1815), and was wounded in the gunboat fight on the latter occasion; led Arctic expeditions 1818, 1819, and 1825; became post-captain and F. R. S. 1823; was knighted in 1829 and received the honorary degree of D. C. L. from Oxford; was governor of Tasmania 1836–43, where he was greatly beloved. In 1845 he set out on his last polar expedition in command of the Erebus and Terror. Many expeditions were sent out in search of the Franklin expedition, and from time to time various relics of it were found; and in 1859 Capt. F. L. McClintock found at Point Victory in the Arctic region conclusive documentary evidence that Franklin died near Lancaster Sound, June 11, 1847, and there is no doubt that all his men also perished, though some long survived.—Franklin's first wife, Eleanor Ann Porden (1795–1825), was a poet; his second wife, Lady Jane, *née* Griffin, was famed for philanthropy and her labor for the recovery of her lost husband. D. July 18, 1875.

Franklin, SAMUEL R.: See the Appendix.

Franklin, THOMAS LEVERING, D. D.: b. at Philadelphia, Apr. 10, 1820; graduated at the Philadelphia Classical Institute 1837; at Trinity College, Hartford, Conn., 1841; and at the Theological Seminary of Virginia 1844; entered the ministry of the Protestant Episcopal Church; was on the missionary committee of the diocese of New York 1853; and of Western New York 1869–70; founded the Jane Grey School, Mt. Morris, N. Y., 1866; was its rector 1866–70; has been active in the work of building churches and rectories, and has occupied various important pastoral charges in his Church. He is the author of a valuable work on *The Creed*, and of several important tractates on *Divorce*, in the treatment of which his canonical learning has been widely recognized. Revised by W. S. PERRY.

Franklin, WILLIAM BUEL: soldier; b. in York, Pa., Feb. 27, 1823; entered the Military Academy at West Point, June 1839; graduated June, 1843, and was assigned to the corps of topographical engineers; served with honor in the war with Mexico. In the civil war he commanded a brigade in Heintzelman's division at the battle of Bull Run July 21, 1861; commanded at the battle of West Point May 6, 1862; at the affair of Golding's Farm June 27, 1862, and at the battle of White Oak Swamp June 30, 1862; was appointed major-general July 4, 1862; commanded the left at the battle of South Mountain, Md., Sept. 14, 1862, capturing Crampton's Gap; present at the battle of Antietam Sept. 17, 1862, in command of the Sixth Corps, relieving Gen. Sumner's command after 12 o'clock; assigned to the command of the left grand division Army of the Potomac Nov., 1862, consisting of the First and Sixth Corps; commanded left wing at the battle of Fredericksburg Dec. 12 and 13, 1862; relieved from duty in the Army of the Potomac Jan. 25, 1863; assigned to duty in the department of the Gulf July, 1863; in command of expedition against Sabine Pass Sept., 1863, which was repulsed; in command of troops occupying Northern Louisiana 1863–64; in command of the Nineteenth Corps and troops of the department of the Gulf, forming the Red river expedition, in Mar. and Apr., 1864, until joined by Gen. Banks on the evening of Apr. 6; in the battle of Sabine Cross-roads, as second in command, on Apr. 7, and in the battle of Pleasant Hill on Apr. 8; conducted retreat to Alexandria; on sick leave on account of wound from June to Nov., 1864; captured on a train from Baltimore to Philadelphia July, 1864, escaping during the next night; president of a board for retiring disabled officers from Nov., 1864, to Nov., 1865; resigned as major-general of volunteers Nov. 9, 1865, and as colonel of the Twelfth Infantry Mar. 15, 1866. He was president of commission for laying out Long Island City 1871–72; president of board of commissioners for building new State-house at Hartford, Conn., 1872–73; consulting engineer of same 1874; was appointed U. S. commissioner-general for Paris Exposition of 1889. Grand officer French Legion of Honor Oct. 20, 1889.

Revised by JAMES MERCUR.

Franklin Falls, N. H.: See FRANKLIN, N. H.

Franklin Island: an island off the coast of Knox co., Me.; on the west side of the entrance to the river St. George. It has a brick lighthouse with a flashing light, standing at the north point of the island; lat. 43° 53′ 31″ N., lon. 69° 22′ 10″ W.

Franklinite [deriv. of *Franklin*, in honor of Benjamin Franklin]: a mineral found associated with red oxide of zinc, found both amorphous and crystalline, chiefly at the Mine Hill and Stirling zinc mines in Sussex co., N. J., and also found at Altenburg, near Aix-la-Chapelle, Germany. It contains from 66 to 69 parts of peroxide of iron, with from 10 to 22 parts of oxide of zinc, and about the same proportion of oxide of manganese. Franklinite is worked for making zinc paint, and the residue, itself called franklinite, is used as a raw material to manufacture *Spiegeleisen* in two works in New Jersey and one in Eastern Pennsylvania.

Franklin Lake: a body of water in Elko co., Nev., E. of the lofty East Humboldt Mountains. It is nearly fresh, very shallow, and is fed by springs doubtless derived from the mountain-snows. The *tulé* (*Scirpus validus*) grows abundantly in the lake, which has no outlet.

Franklinville: village; Cattaraugus co., N. Y. (for location of county, see map of New York, ref. 6–C); on the W. N. Y. and Pa. Railroad; 50 miles S. of Buffalo. It is the center of an important dairying section, and has 2 public schools, 6 churches, casket and canning factories, saw and grist mills, creamery, etc. Its water system is owned by the village, and it has an electric-lighting plant. Pop. (1880) 672; (1890) 1,021; (1900) 1,360.

EDITOR OF "CHRONICLE."

Frank Marriage: a peculiar species of entailed estate formerly in use under the English law (and, subject to statutory modifications, still possible to exist), consisting in a gift of land by a father or kinsman to a daughter or cousin and her husband at the time of her marriage, upon the implied condition that the land was to descend to the issue of the marriage. On birth of issue the condition was regarded as performed, and the estate became alienable. But the passage of the statute *De donis conditionalibus* caused such estates, like others held in tail, to be controlled by the terms of the gift, and to be reserved exclusively for the issue for whom they were originally intended. Such estates were afterward subjected to the same changes as all entailed estates. See ENTAIL. Revised by F. STURGES ALLEN.

Franko, SAM and NATHAN: See the Appendix.

Frankowitz, MATTHIAS FLACH: See FLACIUS.

Frank Pledge: in Old English law, the pledge of one freeman for the good behavior and obedience to law of another; the system by which each freeman of an ancient English tithing (a subdivision of a county, consisting of ten freeholders with their families) was held responsible for the conduct of their fellow-freeholders. Upon the commission of an offense by any one of them, the others were obliged to have him forthcoming to answer the requisition of the law, or, in case of his escape, to bear the burden of any penalty that might be imposed. Revised by F. STURGES ALLEN.

Frank Pledge, Courts of: formerly in England, courts held once in the year in every hundred, lordship, or manor, for the purpose of presenting by jury all crimes committed within their jurisdiction, punishing all trivial misdemeanors, administering the oath of allegiance to every freeholder attaining the age of discretion, etc. All freeholders resident in the jurisdiction, with the exception of prelates, peers, clergymen, women, and minors, had to attend. The business of these courts is now performed by justices of the peace.

Franks, Sir AUGUSTUS W.: See the Appendix.

Franks, The [the O. H. Germ. *Franchun*, Mod. Germ. *die Franken*, is a deriv. from a word for lance, **francho*; cf. O. Eng. *franca*]: a group of Teutonic tribes that in the fifth century A. D. left their homes in the low countries N. of modern France, overthrew the Roman power in Transalpine Gaul, and laid the foundation of the Frankish empire.

1. *The Name and Peoples Embraced thereunder.*—The name is of later origin than the first historical appearance of the different peoples designated thereby. The tribes embraced two and a half centuries later under this name had already, during the reign of Augustus (27 B. C.–14 A. D.), appeared upon the Rhine and in their contact with the Roman civilization been drawn into historic notice. The Bructeri, Chamavi, Amsivarii, Catti, Chassuarii, and especially the Sygambri, mentioned by the Latin historians of this period, were the tribes which formed the nucleus of the later confederation of the "Franci." They had already at that time, in small pioneer groups, pushed across to the *left* bank of the Lower Rhine, while they occupied the territory on the right from the mouth of the Ems to the Sieg and Werra. After the middle of the fourth century appear the two groups of this Frankish confederation under the names Salian and Ripuarian—the former inhabiting the districts of the Lower Rhine, Meuse, and Scheldt, and deriving its name probably from the river Sala (present Yssel); the latter inhabiting the territory of the Middle Rhine in and about the present city of Cologne, and named from its riparian situation.

2. *Their Place in Teutonic History.*—Their problem in the civilization of Europe was the mediation of the Roman-Christian civilization with the Germanic; or, better, it was theirs to receive the inheritance of the Roman-Christian culture—to form, reform, develop, and supplement it by and with the freshness and vigor of the Germanic nature, and at the same time be formed, reformed, developed, and modified by it. The sinking Roman world delivered to the Franks the world-historic inheritance which it had itself received, increased, and stamped with the forms and characteristics of its own nature; theirs it now became to take up this world-civilization, and by the developments and modifications to which they subjected it, and it them, to present it as their form of the world-civilization, and be presented by it as its first expression through the Germanic man, and so furnish the connecting link between the antique classic world, with its speculative and ritualistic religiosity, and the scientific political world of the new time, with its ethically religious views.

3. *The Characteristics and Conditions which made the Franks the First World-historic People of Germanic Nationality.*—*a. Their Geographical Position and Agricultural Nature.*—We find them as early as the middle of the fourth century separated into the two branches of Salian and Ripuarian, and occupying the fertile plains on the lower course of the Scheldt, Meuse, and Rhine. While thus the other German tribes, during the great "wandering of the peoples," separated themselves entirely from their original homes, and, spreading themselves like a thin lamina over other nationalities, were soon absorbed by and disappeared in the same, the Franks, on the other hand, maintained their geographical connection with the old Germanic home, from which they continued to draw new freshness and vigor by which to oppose the deteriorating and disorganizing influences of the decaying Roman world. Sustained thus from behind, they pushed gradually and peacefully (as compared with the warlike convulsions which the great immigration was elsewhere producing) forward, never forgetting in their new acquisitions the worth and importance of the old; settling their lands as they gained them, and reducing them to cultivation; uprooting and destroying the scanty remnants of the Celtic, and at first of the Roman-Christian, civilization; in a word, thoroughly "Germanizing" as they pressed forward.

b. Their Attitude toward the Roman State.—While the other German tribes and peoples, for the most part, waged an open and unceasing warfare with the Romans for supremacy and existence, the Franks, on the other hand, after the first brushes of conflict with the Roman commander Aetius in Gaul, who, in 428 A. D., and again in 431 A. D., checked their southwestward movement, acknowledged the political supremacy of the Roman state, occupied peacefully the land as far as the Somme by consent of the Roman commander, and tolerated the Roman rites and religion, while their king Clovis received distinguished Romans at his court; in a word, they gradually and almost unconsciously, both to themselves and their national opponents, secured to themselves the substance of power, leaving to the Romans only the outward show. And not until the Roman governor, Syagrius of Soissons, had separated himself by his own usurpatory act from the source of his authority in Ravenna or Constantinople, and thus lost in the eyes of his Roman-Gallic subjects his show of legitimacy, did the Frankish king Clovis abolish these scanty remnants of Roman supremacy, and, while extending his dominions to the Loire, joined to the substance of the power which he already possessed the outward form of sovereignty (486 A. D.). Under such circumstances neither the Roman emperor at Constantinople nor the Roman-Gallic subjects took any offense at this procedure. On the contrary, after Clovis's victory over the Visigoths (507 A. D.) the Emperor Anastasius bestowed upon him the dignity and title of a Roman patrician, and appointed him Roman proconsul in Gaul; and though the Frank owed his supremacy, for the most part, to his own good sword, yet he was by no means blind to the advantage of the legitimation of his title in the eyes of his Roman-Gallic subjects by the legitimate Roman emperor. He received the dignity with reverence, caused the ceremony of coronation to be performed upon himself, and was greeted by his subjects as consul and Augustus, thus settling all dispute between Frank and Roman in regard to the right of his sovereignty.

c. Their Attitude toward the Orthodox Romish Church.—It has already been said that the Franks in their earliest appearance on the Scheldt began to root out and destroy the scanty remnants of the Roman-Christian as well as of the Celtic culture, but that, as they proceeded toward the S. W., and occupied the lands to the Somme under the recognition of the political supremacy of the Roman governor at Soissons, this opposition to the Christian culture was changed to tolerance, which of itself gave to the Franks a very great advantage in their relation to the Roman-Gallic population as compared with the other German tribes upon Gallic soil, since these, for the most part, were Arian Christians, and unceasing in their persecution of the orthodox branch of the Church, to which the Roman-Gallic inhabitants for the most part adhered. If mere tolerance therefore produced such advantage, what if the Franks should become the outspoken defenders of Romish-Christian orthodoxy? Yea, what if they should become orthodox Christians themselves? But here was a difficulty, or rather a great series of seemingly insurmountable difficulties. In the nature and history of the Franks every presupposition and condition for such a conversion seemed to fail. First of all, the readiness to break with the past, the despair of coming to anything upon the old lines of activity, the repentance and consciousness of imperfection necessary to a change of religion, were entirely wanting—yea, inconceivable—to the young, fresh, hopeful, active Germanic nature, all glowing with the recollection of its heroes of the past, and striving to imitate them. Then, again, the Christian religion was the religion of the Romans, their national enemy. The Christian God, according to their way of thinking, gave to the Romans their victories and brought to the Germans their defeats. To become a Christian was therefore to become a Roman in sympathy—in other words, a traitor. Then, again, the principles of Christianity emphasized at that time found but little sympathy in the nature of the German. The lowly, patient, and humble Jesus was anything but his idea of a perfect manhood. A proud, vigorous, belligerent, and successful individuality was to him the only example worthy of imitation. And when one turns to the speculative and moral sides it was no better. The preliminary philosophical study and development of language necessary to convey and receive such ideas—as, for instance, the doctrine of the Trinity—were entirely wanting, while the principle of blood-revenge for injury to one's self or family was the German-heathen correspondent in morals to that of brotherly love in Christianity. Many years of contact with the Romans had perhaps, in some features, softened the bluntness of the opposition; still the Franks remained entirely true to their heathenism, and the only perceivable effect of this contact was an indifferent toleration for Christianity as one of the Roman institutions. All natural conditions were thus lacking, and nothing short of a course of events miraculous in their nature to the minds of the Franks could secure their conversion; and such a conversion must and did establish peculiar, and in some respects dangerous, relationships to the ecclesiastical power. About 493 A. D. the Frankish king Clovis took for his consort an orthodox Christian, Clotilda, daughter of King Chilperic of Burgundy, who shortly before the marriage of his daughter had been murdered by his own brother Gundobald, also king in Burgundy, and an Arian by profession. The orthodox Christians of Gaul believed that difference of creed was the cause of the murder, and it fired their souls with hatred against Gundobald. Clovis inherited by his marriage with Clotilda, according to the German law of blood-revenge, the duty of revenging the blood of his father-in-law. Here, at least, was one point of sympathy between him and the orthodox inhabitants of all Gaul. Clotilda lost no time in attempting by her persuasions to extend this sympathy on the part of her consort, but in vain. Clovis gave way only so far as to allow his first-born son to receive the Christian baptism. A few days afterward the babe sickened and died. A second was born to him, and likewise, through the persuasions of Clotilda, subjected to the Christian rite. In five days this child sickened and came near unto death. It is difficult for men of our day and way of thinking to represent to themselves the thoughts and emotions of Clovis at this critical juncture. In allowing these acts he had been a traitor to the gods of his fatherland—those gods who had rewarded with victory and success his devotion to them, and who now punished his treason. It was therefore a matter of no small moment that this child recovered, and that the Christian God thus vindicated himself (so to speak) and his power in the eyes of Clovis. Thus aroused, disturbed, and excited in spirit, the Frank neared the decisive instant. The Alemanni, a warlike German tribe occupying both sides of the Rhine from Mayence to Basel, pressed hard against the Ripuarian Franks, whose king, Sigebert, with the aid of Clovis the Salian, prepared to meet them in battle. The conflict took place in the neighborhood of the present city of Zülpich (496 A. D.). The Franks fell by thousands; complete destruction threatened them. In this moment of despair, and doubt in the power and inclination of the gods of his own worship to save him, Clovis lifted his eyes to heaven and pledged himself by an oath to receive the Christian God, the God of his Clotilda, if that God would only prove his power and favor by securing to him the victory. Then, inspired by the sublime loftiness of this wager of his faith, he plunged once more into the heat of the battle, and won. The God of the Christians had by this miracle vindicated his right and claim to the faith, the devotion, and the sword of the Frank; and the conversion was complete. Clovis and 3,000 of his followers received immediately the Christian baptism from the hand of the Bishop Rhemigius of Reims, and vowed their allegiance to the orthodox Church. The manner of this conversion was the undoubting reception by the Franks of the Romish-Christian Church in its totality as the infallible organ of the invincible God. Neither the reasonableness of the orthodox doctrine nor the examples of its votaries had produced this change in the Frankish mind, but the Christian God had proved himself the superior God of the universe in the miracle of the victory over the Alemanni, and had also manifested therein his favor for the Franks. And that was enough for him. Under his favor and by his power the Frank now felt himself invincible and called upon to subdue the world to his scepter. But the Frank knew nothing of this God save as presented by this Church through its priesthood. This Church was to him a prehistoric institution. He knew nothing of its origin or development into its then existing ecclesiastical form. The command of the priest was to him the command of the Christian God, and service to the Church was service to that God. In a word, the manner of the conversion of the Franks to the Romish-Church Christianity forestalled all distinction between that Church and Christianity, and bound the hopes of the Frank for victory and success together with faith in the invincible divine power of that Church.

Enabled thus, by their geographical position, to draw continually fresh vigor from the old Germanic home, legitimized politically by the Roman emperor in the eyes of the Roman-Gallic subjects, drawn into most intimate sympathy with the same through the bonds of a common religion, and inspired with the idea of being the favored people of the invincible God, the Franks rapidly overcame all opposition on the part of other tribes and peoples, and at the death of Clovis (511 A. D.) had extended their kingdom and sovereignty from the Garonne and the borders of Septimania to the mouth of the Scheldt, and from the Atlantic on the west to Thuringia on the east.

4. *The Merovingian Government.*—Through the long years of constant warfare and motion during the immigration of the Teutonic peoples the chief command in war and in immigration had gradually become hereditary, chiefly because, in the absence of other educational means, the father would most naturally train up his own son to the duties of the chief command. The assumption of a state of peace at the close of the "great wandering" was gradual, and the ruler in the half-nomadic war continued the ruler in peace, the military leader became the king, the *Herzog* became the *König*. The first Frankish king of whom there is any mention was Clodio, while the second, Merovius, founded the dynasty which Clovis fixed firmly in power. The government was thus, by the nature of its origin, a monarchy —not a constitutional or absolute or feudal monarchy, nor yet a military monarchy in the modern sense of that term, but the patriarchal monarchy in its most warlike type. The king's court was the central point of the government. No distinction was made between the king's private property and the state treasury. The officers of his household were *ex officio* the highest officers of the state, the majordomo at their head. The government was administered through the agents of the king—viz., counts and bishops—and these officials, as well as all servants and favorites of the monarch, were paid or rewarded by grants of land, the only species of property at hand in sufficient quantity for the purpose at that stage of Teutonic civilization. The lands thus granted were already inhabited and cultivated by a Romish-Gallic peasantry; and, since no distinction had as yet arisen between public and private functions, the king's grant of land transferred the people dwelling thereon to the political jurisdiction of the grantee—that is, exempted the inhabitants of these grants from the immediate power of the king. Of course, such an economy of the treasury must, sooner or later, result in the exemption of the entire territory of the Frankish crown from the immediate power of the king, and raise up a powerful and defiant nobility which he could not control. This cause, taken together with the conflicts engendered by the absence of any fixed law of succession within the royal family itself, and the degeneration of the Merovingian dynasty through contact with the decaying Roman world, brought the Frankish state, after an existence of more than two and a half centuries, near to its dissolution.

5. *The Carlovingian Reform.*—The Carlovingian dynasty was in its origin the ducal house of the Ripuarian Franks. This branch of the Frankish folk had remained upon the soil of the fatherland, and, though united with the Salians in the confederacy of the Franci, had preserved the Germanic freshness and vigor, while the closer contact of the

latter (the Salians) with the decaying Roman world upon Gallic soil had produced weakness and decline. As at the close of the seventh century and the beginning of the eighth the dissolution of the Frankish state became imminent, three mighty dukes of the Carlovingian house, Pepin von Landen, Pepin von Heristal, and Charles Martel, gradually and successively gathered into their own hands all political power—first in Austrasia, the more German half of the kingdom, sometimes wearing the title of major-domo, to lend the show of legitimacy, sometimes not; and then in Neustria, the more Romanic half, where, having no ducal authority, the office of the major-domo was always assumed for the sake of legalizing their sovereignty over their West Frankish subjects. By the influx of this fresh and vigorous German element the process of dissolution was checked and the unity of the Frankish state restored. The Carlovingian dukes broke the independent power of the defiant nobility; brought the royal domain back to the ownership of the crown; established the principle that the grant of crown-lands meant only the grant of the use of the same, and that only upon condition of service to the state; extended the boundaries of the kingdom; planted the Church in new places; lent their aid to Boniface in the conversion of the Thuringians, Frisians, and part of the Saxons; and successfully defended the European-Christian civilization against the terrible Moslem invasion. Not until they had virtually ruled the Frankish state for more than fifty years, and had grounded their power through these mighty achievements, did they move for the possession of the crown in their own name and right. It was Pepin le Bref who submitted this question first to an assembly of the magnates of the kingdom, and then, after receiving their approval of his design, took one more step in the legitimation of his title, which, at the same time that it accomplished most thoroughly its aim, laid also the foundation for ideas, conceptions, and claims which from that day to this have filled the centuries with intellectual contest, and oft with bloody warfare; this step was the appeal to the Roman pontiff for the recognition of his authority as King of the Franks. Upon the reception of the affirmative reply of Pope Zacharias, Pepin was crowned and anointed by the presiding bishop at Soissons in May of 752 A. D. From this time forward the unity of Church and state in the Frankish kingdom became closer and closer. The bishops exercised more and more of the functions of political officers over the inhabitants of the bishoprics. The extension of the kingdom by Pepin and Charlemagne was at the same time a missionary movement for the planting of new churches, the establishment of new dioceses, and the conversion of new peoples. At length, after the mighty Charlemagne had reduced to the sway of his scepter all the territory of Europe, from the Ebro to the Eider, and from the Frisian coast to Dalmatia and the southern shores of Italy, Pope Leo III. set the crown of the Roman emperor upon his head in the Church of St. Peter's at the grave of the apostles, and the Roman people greeted him as emperor and Augustus (Christmas Day of the year 800). With this it was said that the Roman-Christian empire of Constantine had been restored—restored as the feudal grant of the Roman pontiff to Charlemagne. It is not probable that Charlemagne himself so considered it. He undoubtedly thought that it was the Romans' way of acknowledging that which already existed independent of them. This is clearly seen in the fact that Charlemagne crowned with his own hands his son Louis the Pious as his imperial successor, without any regard to the pope. Still the manner of the origin of the imperial title gave a color and a moment to the papal assumption of the power to grant and confiscate thrones which the entire Middle Ages did not shake off. During the reign of Charlemagne (768–814) the Frankish state stood at the summit of its power and glory. But the strength and endurance of personal government always depend upon the capacity of the ruler, and when the mighty personality which created the great empire was no more, and his only surviving son, Louis the Pious—a character to wear a cowl, but not a crown—succeeded to the sovereignty, the dissolution began. The wealth of the crown and the powers of the state were squandered upon the clergy, and the latter half of the weak monarch's reign was a constant scene of conflict between his sons in regard to the succession. At length it came, after the father's death (840 A. D.), to the compact of Verdun between them (Aug., 843 A. D.), according to which the eldest, Lothair, received Italy, which he ruled already, and the district called after his name Lothairingia or Lorraine, reaching past the Rhône and Rhine to the North Sea. Louis the German received the more German portion of the empire, E. of Lothair's kingdom, and Charles the Bald, the Romano-Gallic portion W. of the same. This compact of Verdun may therefore be looked upon as the birth-moment of the three great nationalities—German, French, and Italian—whose friendships and hostilities, workings and interworkings, influences and reflex influences upon each other have formed the substantial part of European continental history for the last thousand years. The peoples out of whom these three great nationalities were to be developed had been bound together in this mighty political structure of the Frankish state. By the power of this unity, whose chief and fundamental bond was a common religion and a common Church, they had succeeded to the inheritance of all that was destined to be of world-historic value in the civilization of the Roman world. Amid all the wreck and ruin of the centuries of the "great wandering" the Church alone, of all institutions, had stood firm, and now, as the established religion of the Frankish empire, it transmitted to all the peoples of this great state-unity the culture of the Roman world, which it had accumulated and preserved. In this the Frankish state had accomplished its work in the world-historic plan. The peoples brought together to participate in a common civilization by it now separate, each to go its own way—each to develop, supplement, and work up in its own way that which it had received—each to make its own valid at the expense of the rest. The elements clash against each other; sharpen, purify, and develop, thereby, themselves and each other; fall into false connections; become again dissolved, until at last the proper affinities, positions, and relations are found, and the active, intelligent, and reflected harmony of the new time begins to appear.

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Franqueville, Comte de: See the Appendix.

Franz, fraants, ROBERT: song composer; b. in Halle, Germany, June 28, 1815; received a university education, and only after long opposition secured the consent of his parents to study music; studied under the best masters, and made a special study of the works of Bach, Beethoven, and Schubert. In 1843 he published his first set of songs, which attracted the notice of Schumann, and later that of Mendelssohn and Liszt. He ranked as one of the greatest song composers Germany has ever produced, and during his lifetime he published 257 songs for a single voice with pianoforte accompaniment. During the later years of his life he gave much attention to editing the works of Bach and Händel, and his additional accompaniments to the *Messiah* occasioned much controversy in the musical world. They are elaborate, scholarly, and certainly do much toward modifying the archaic character of that work. D. in Berlin, Oct. 24, 1892. D. E. HERVEY.

Franzensbad, fraants'ens-baat: town of Bohemia; county of Eger; on railway; 3 miles N. W. of Eger (see map of Austria-Hungary, ref. 3-C). It is a celebrated bathing-place. The waters of its nine mineral springs are very efficacious in scrofulous diseases; 500,000 bottles are annually exported. Pop. (1890) 1,944.

Franz Josef Land: See the Appendix.

Frascati, fraas-kaa'tee: a town of Central Italy; 12 miles S. E. of Rome; on the slope of the Alban hills, and celebrated as a summer resort (see map of Italy, ref. 6-E). It was built, after the destruction of ancient Tusculum in 1191, on the ruins of a villa overgrown with underwood (*frasche*), whence its name. It is the seat of a bishopric and has two cathedrals, one dedicated to San Rocco, dating from the fourteenth century, and one dedicated to San Pietro, dating from the seventeenth century. Pop. 7,134. The town is now interesting chiefly on account of its palatial villas. The Villa Falconieri is the oldest of them; it was built in 1550 by Cardinal Ruffini. The Villa Mandragone is the largest; it was built in the sixteenth century by Cardinal Altemps, belongs to the Borghese family, and is partly occupied by a Jesuit school. The Villa Ruffinella, or Tusculona, also dates from the sixteenth century; it was the residence of Lucien Bonaparte, but was afterward bought by Victor Emmanuel. In the chapel are the tombs of Lucien Bonaparte, his wife, his father, and his son Joseph. The Villa Conti, formerly called Villa Ludovisi, belongs to the Torlonia family. In the Villa Piccolomini, Baronius wrote parts of his *Annales*. But the most beautiful of all the villas is the Villa Aldobrandini, belonging to the Borghese family. It contains frescoes by Arpino.

Fraser, frā'zer, Alexander Campbell, LL. D.: philosophical writer; b. at Ardchattan, Argyleshire, Scotland, Sept., 1819; educated at the University of Edinburgh; in 1846 appointed lecturer on Mental Philosophy in the New College, Edinburgh. From 1850 to 1857 was editor of the *North British Review*, succeeding Sir William Hamilton in the latter year as Professor of Logic and Metaphysics in the University of Edinburgh. Besides many valuable contributions to the *North British Review* and other periodicals, he is the author of *Essays in Philosophy* (1856), *Rational Philosophy* (1858); in 1871 he published a collected edition of the *Works* of Bishop Berkeley, with dissertations and annotations: also the *Life and Letters of Bishop Berkeley, with an Account of his Philosophy*, and in 1890 a volume on *Locke*.

Fraser, Charles: painter; born in Charleston, S. C., Aug. 20, 1782; studied law, was admitted to the bar, and practiced with such success that his art studies were suspended. In 1818 he renounced the profession of the law and devoted himself to painting. In the department of miniature he chiefly excelled, though historical subjects and landscape tempted him. His popularity in his native city was great. At an exhibition of his works held there in 1857 there were 313 miniatures and 139 paintings in oil of other styles. Mr. Fraser was a man of letters, as well as an artist. D. in Charleston, Oct. 5, 1860.

Fraser, Christopher Finlay: Canadian politician; b. at Brockville, Ontario, in 1839; studied law, and was admitted to the bar in 1865. He was elected to the Legislative Assembly of the Province of Ontario in 1872, and re-elected at each successive election up to and including that of 1890. He was provincial secretary and registrar 1873–74, and the latter year appointed commissioner of public works. He was one of the originators of the Ontario Catholic League. D. at Toronto, Ontario, Aug. 24, 1894. Neil Macdonald.

Fraser, Donald, D. D.: Presbyterian minister; b. in Inverness, Scotland, Jan. 15, 1826; graduated M. A. at University of Aberdeen 1842; studied theology at Knox College, Toronto, and New College, Edinburgh; pastor in Montreal, Canada, 1851–59; Inverness, Scotland, 1859–70; Marylebone Presbyterian church, London, 1870–92. He published *Synoptical Lectures on the Books of Holy Scripture* (3 vols., London, 1871–76; 4th ed. 2 vols., 1886; the lectures on the New Testament in Italian, Florence, 1878); *The Church of God and the Apostasy* (London); *Life of Thomas Chalmers, D. D.* (London and New York, 1881); *The Speeches of the Holy Apostles* (1st and 2d eds. London, 1882); *Seven Promises Expounded* (London); *Metaphors in the Gospels* (London, 1885); *Mary Jane, Lady Kinnaird* (London); *Sound Doctrine* (London, 1892). D. in London, Feb. 12, 1892.

Willis J. Beecher.

Fraser, Simon: See Lovat, Lord.

Fraser, Thomas Richard, M. D., F. R. S.: author and teacher; b. in Calcutta, Feb. 5, 1841; graduated at University of Edinburgh 1862; became Professor of Materia Medica there 1877; Professor of Clinical Medicine 1878; dean of the faculty of medicine 1880; and has devoted his attention chiefly to the determination of the physiological effects of drugs. He is member of several distinguished societies, and is author of *Characters, Actions, and Therapeutic Uses of Physostigma Venenosum* (1863); *The Physiological Action of Physostigma* (1866–67); *On the Connection between Chemical Constitution and Physiological Action* (conjointly with Prof. Crum Brown, 1868–69); *An Experimental Research on the Antagonism between the Actions of Physostigma and Atropia* (1870–71); *The Dyspnœa of Asthma and Bronchitis, etc.* (1887); *Strophanthus hispidus: Its Natural History, Chemistry, and Pharmacology* (1889); and many others.

Fraser River: a river of British Columbia. Next to the Columbia and the Yukon, it is the largest American river falling into the Pacific. It rises by two forks, one of which flows S. E. from near 54° N. lat. and 125° W. lon. for 250 miles, while the other flows from the Rocky Mountains (in lat 53° 25′ N., lon. 118° 40′ W.), and reaches the junction after a N. W. course of 200 miles. The union is near Fort George (about 53° 25′ N. lat., 122° 40′ W. lon.). The course of the main stream is southward for 800 miles. Large steamers ascend it for 150 miles from its mouth to Fort Hope, and at high water they can go up 12 miles farther. Large sea-going vessels mostly stop at New Westminster, 75 miles from the Gulf of Georgia. The Fraser river is chiefly important for the rich gold mines along its banks, and for its salmon-fisheries, which are of the first importance. The river flows throughout a great part of its course in deep cañons, with a rapid current. Its mouth is near the U. S. line, on the Gulf of Georgia. Fraser river affords five species of salmon, and in the spring its estuary contains millions of the *oulachon*, or candle-fish, a fine smelt (*Thaleichthys pacificus*), which is very valuable for food and oil. Along its banks there are good timber and fur regions and some fine grazing-lands. The lower Fraser valley is densely timbered.

Fraserville, Canada: See Rivière du Loup.

Fraternal Insurance Societies: associations having for their object the insurance of the lives of their members and the rendering of pecuniary aid in case of sickness, injury to person or property, and in other exigencies of life. Strictly speaking, the lodge feature is a necessary characteristic of such societies, but since the general principles underlying all organizations known as assessment or co-operative insurance societies are identical, the present article includes a brief treatment of those which lack the fraternal elements of lodge system and ritual. In Great Britain associations similar to the fraternal insurance societies of the U. S. are called Friendly Societies (*q. v.*). All assessment insurance societies, whether strictly fraternal or not, meet death-claims by levies after a death upon the members of the associations, and have the legal power to increase or lower this levy as it may seem best. *Business assessment societies*, as those which lack the lodge system are commonly called, employ agents on salary or commission to transact their business, while the strictly fraternal societies do not employ such agents except in the preliminary organization of local branches.

Nature of Assessment Insurance Societies.

"It is probable that not one person in a hundred," writes one of the Massachusetts insurance commissioners, "takes his insurance with an intelligent appreciation of the relative merits of the companies or the plans they present. The uninitiated are overwhelmed by the volubility of the agent and his audacious prophecies." There is no business involving such large financial interests as life-insurance upon which there is such general ignorance. Yet the underlying principles are very simple. Let us start with that which is easiest to understand, though not first in point of time, assessment insurance, such as prevails in fraternal associations. A considerable number of people, the greater the better in order to avoid violent fluctuations of death-rate, form an association, and agree to assess themselves sufficiently to pay the heirs of each one on death $1,000, and to pay the expenses of management. The latter may vary from $1 to $4 a year for each $1,000 of insurance carried. The assessments for death-losses or mortality cost on this plan will evidently vary with the number of deaths. In a new association, where all the members are in the prime of life and have had to pass a thorough medical examination before becoming members, the mortality may not and often does not for a few years exceed eight in a thousand. If in an association of 5,000 persons 40 die yearly and $1,000 is paid to the heirs of each, $40,000 must be paid by the 5,000, or $8 each. As some of the 40 in this illustration would die early in the year and escape assessment, the 4,960 would have to pay a trifle over $8 each, but it may be said roughly that the cost per $1,000 insurance carried, aside from costs of management, will be the same as the mortality per thousand lives. As the association grows older the rate of deaths and assessments tends to rise to over sixteen in the thousand, unless the association can gain young, vigorous recruits much faster than the general growth of population.

As a result of the experience of several hundred thousand lives, the so-called Combined Experience Mortality Table has been prepared. Though some think it puts the death-rate too high, it has been accepted as the standard by

New York and Massachusetts law. According to this table, of 100,000 persons living at the age of 20 there will die that year 729. Of 100,000 at 25 the number will be 777; at 30 it will be 842; at 35 it will be 929; at 40 the mortality is 1,036; at 45 it is 1,221; at 50 it is 1,506; at 55 it is 2,166; at 60 it is 3,034; at 65 it is 4,408, and at 70 it is 6,493.

For people of all ages to pay the same rate of assessment at the death of a member has seemed to most associations unjust to the younger members, and assessments have been, with a few exceptions, graded according to age at entrance. Many of the business assessment companies proceed one step further and assess during the youth of the association and also of the insured more than is necessary for current needs. This surplus is put into a reserve fund to be used in later years, or at least the interest on the fund, to save the need of increasing assessments. Yet full power is reserved to levy all assessments needful.

Old Line or Level Premium Insurance Companies.

Quite different is the plan of the so-called *old line* or level premium companies, against which fraternal associations were formed as a protest in the seventies. The level premium company has no right of assessment, but is legally bound to collect from every one such an equal yearly sum as will, when improved at 4 per cent. compound interest, suffice to pay the death-claims of all, as they die, after living out on the average their normal expectation of life. Given an interest and mortality table and it is a simple matter to fix the equal annual premium. Any profits earned in excess of the legal rate serve in mutual companies, and even to some extent in stock companies, to give dividends to policy-holders that will lighten their annual premiums more and more until the maturity of the policy.

The ratios of expenses of management to mean amount insured in the five largest level premium companies have been as follows on each $1,000:

COMPANIES.	1872.	1879.	1885.	1892.
The Equitable (New York)	$8 40	$7 90	$8 70	$8 50
The Mutual (New York)	4 70	5 80	6 90	10 30
The Mutual Benefit (Newark, N. J.)	5 10	4 70	5 80	7 10
The New York Life (New York)	7 80	8 10	10 80	10 50
The Northwestern Mutual (Milwaukee)	7 90	7 20	8 10	8 30

The average cost of all the old line companies doing business in Massachusetts was $8 in 1880, $9 in 1887, and $9.30 in 1892.

To fraternal societies doing business on the lodge system the expenses of management bear a much smaller ratio to the mean amount insured, averaging, in addition to between $2 and $3 per $1,000 to cover lodge dues and local medical fees, no more than 48·04 cents on the $1,000 in 15 of such associations, and 72 cents in 10 others. This disparity is due to the saving in expenses to the fraternal orders on account of the management of their own interests by the insurers through the lodge system.

Origin and Growth of Assessment Insurance Societies.

Fraternal sick and funeral benefit associations, paying usually from $50 to $100 funeral benefit and $5 a week in case of sickness, had existed and in some measure flourished in the U. S. even before the civil war. Two such now doing business in Connecticut were organized in 1821, and eleven others between 1831 and 1857. Associations on the assessment plan, however, that emphasize the life-insurance side only, date in the U. S. from 1866. At about the same time appeared the three kinds of assessment associations, business assessment companies, secret fraternal life-insurance societies with branches or lodges, and other secret fraternal life-insurance societies sometimes called fraternal orders, that were without lodges or branches, but worked entirely through a central staff of officers, as do the business assessment companies, but, unlike the latter, were confined to some class or occupation or secret fraternity, and did not employ paid agents, at least on any extensive scale, to increase membership. On Nov. 12, 1866, some members of the Masonic fraternity at Newark, N. J., organized what the historian of the movement, Mr. George D. Eldredge, considers the first assessment life-insurance company in the U. S. Many other societies of Masons and Odd Fellows immediately took up the idea.

In 1879, of 136 assessment associations investigated by the congress of assessment associations, 64 were Masonic, with 69,844 members and $120,202,588 insurance; 37 were Odd Fellows', with 36,439 members and $44,427,544 insurance; 8 were Jewish, with 22,625 members and $23,909,000 insurance. Nearly all of these associations transacted insurance business through a central office only, without branches or lodges, though the members independent of insurance belonged in most cases to fraternal lodges. For convenience we will henceforth class all such life-insurance societies as *fraternal orders without branches.* Fraternal societies transacting their business through the lodge system may for convenience be designated as *fraternal lodge life-insurance societies.* These, together with *business assessment societies,* numbered 27 in 1879, contained 120,510 members, and carried $239,346,475 insurance. These three classes of assessment insurance societies will be treated in order.

I. Fraternal Life-insurance Orders without Branches.—As the fullest investigation and comparison of fraternal orders, both with and without branches, has been made in Connecticut, and published in the report for 1891 of the Bureau of Labor Statistics of that State, Connecticut may be regarded as typical of the whole country. The *Masonic Mutual Benefit Association of Connecticut,* a fraternal order without branches, was established at Hartford in 1867 to insure the lives of Freemasons. A board of twenty-eight directors elected at the annual meeting chooses the officers. The board holds monthly meetings, calls the assessments, and conducts all the business. Any Freemason in good health is eligible to membership without a medical examination. In Class A, which pays $200 at death, the admission fees are graded from $3 under 25 years of age to from $15 to $60 at the age of 60 or over, as the directors may determine. The assessment is $1.10 on the death of a member, of which 10 cents is devoted to expenses. Class B, which pays $1,000, can be entered by members of Class A on paying an admission fee of $3 and an advance assessment of $5.50. There are graded yearly dues, according to age in this class, from $1 at 35 to $7 at 57. A reserve fund of $8,000 has already been accumulated toward the $18,000 estimated as necessary to pay the last man. The membership in 1892 was 442. The *Odd Fellows' Mutual Aid Association of Connecticut,* another typical association of this character, contained 2,858 members Dec. 31, 1891. Organized in New Haven, Nov. 16, 1867, its government resembles that of the society just described. The initiation fees are graded from nothing between 21 and 35 years of age to $10 between 46 and 50. Medical examinations and age limits were introduced a few years ago. The younger members being dissatisfied with the equal assessment of $1.15 at all ages, assessments were graded in Oct., 1887, from 60 cents on $1,500 between 21 and 24 years of age to $1.50 between 45 and 50 years inclusive.

A statistical comparison of the fraternal orders without branches and the fraternal lodge societies in Connecticut reveals the following facts: The membership of the former throughout the entire State increased but 4 per cent. from Jan. 1, 1887, to Dec. 31, 1891, while of the latter the membership increased nearly 94 per cent. during the same period. In 1891 the average size of the policy in the former was $1,351; in the latter, $1,626; and the payments for death-claims in the lodge societies were less than half those of the orders without branches, this difference being partly due to the greater age and stationary size of the latter societies, and partly to their less care, especially in their early history, in the selection of young and healthy members. While the societies with branches spent 53 cents per $1,000 insurance in 1891 on sick and funeral benefits, there are no returns under this head in the orders without branches, and probably these orders provide very little in this direction, for many of them insure only those who through membership in social secret fraternities get, in that way, such benefits. As a very partial offset to the greater expenses for death-claims of the fraternities without branches, their expenses for management in 1891 were only 95 cents, as contrasted with $1.93 on each $1,000 insurance in the orders with lodges. The difference was doubtless due to lodge expenses directly connected with insurance. The average income from initiation fees and dues per $1,000 was $3 in the fraternal societies with branches and $2.18 in the others. The receipts from death assessments were $9.79 in the former, part of which seems to have gone into the small reserve fund maintained by many of the lodge orders. The assessments for death in the other orders amounted to $14.50. The remaining $1.10 of payments under this head must have come from reserve funds or interest on such. The proportion of various occupations in the fraternal associations with and without branches is given in the following table:

OCCUPATION.	Societies with branches.	Societies without branches.
In business	21·16	40·29
In the professions	5·33	14·74
Well-paid mechanics	38·65	27·37
Lower paid mechanics	20·28	6·35
Clerks	11·20	11·25
Farmers	0·66	.....
Housewives	2·72	.....
Total per cent	100·00	100·00

It will be observed that the societies without branches have a smaller proportion than the others of business and professional men, and the same percentage of mechanics, and that they alone include farmers and housewives. The mortality in 1891 among the orders with branches was 7·9, and among the other orders 14·5. The reserve funds were $4.64 per member with the former and $10.72 in the case of the 8,751 members among the orders without lodges that made returns.

II. Fraternal Lodge Life-insurance Societies.—The *Ancient Order of United Workmen* was organized Oct. 27, 1868, at Meadville, Crawford co., Pa. Its founder was John Jordan Upchurch, a machinist, who was at that time in the employ of the Atlantic and Great Western Railroad. The order was not primarily intended as an insurance or benefit-paying organization, its more prominent feature being to provide for the adjustment of the differences arising between capital and labor. This feature of its organization, however, was soon eliminated, and the beneficiary and protective element became paramount. The society consists of subordinate lodges, grand lodges, and a supreme lodge. The subordinate lodges are under the direct supervision of the grand lodge, which is formed by representatives elected by members of the subordinate lodges. The supreme lodge, organized Feb. 11, 1873, consists of representatives elected by members of the grand lodge. The supreme lodge exercises general control and supervision over the entire order, making general laws and rulings for its government. Grand lodges enact laws and regulations governing the subordinate lodges, which must not be in conflict with the general laws and regulations of the supreme lodge. This order was the first in the U. S. to introduce through a lodge system the payment of a stipulated sum on the death of a member. In fact, it is mainly through its influence and success that assessment insurance has been established and the system demonstrated to be feasible.

The Ancient Order of United Workmen, Jan. 1, 1893, consisted of 4,618 subordinate lodges, 31 grand lodges, and the supreme lodge. Its membership at that date numbered 308,575 members in good standing. It paid to the beneficiaries of deceased members during the year 1892 $6,015,020.60, and since its organization has paid the total amount of $44,570,948.89. Its total expenses for conducting its business for the year 1892 amounted to $462,514.89. As all its policies are for $2,000 each it had at risk on Jan. 1, 1893, $617,150,000. The order levies the same assessment on all its members.

Such a burdening of the younger members can be made tolerable only by their staying in the association until they reach old age—i. e. until the young in turn pay for part of the deaths of those formerly young members, but now old. Most actuaries hold that this must tend to deter the young from joining or lead to early withdrawal, and thus the association would be abandoned to the old with a high resulting death-rate. Yet these results do not seem to have followed in the case of the Ancient Order of United Workmen, except to some extent in Ohio, Kentucky, Tennessee, California, New York, and Pennsylvania.

The average mortality rate was 11·11 for 1879 to 1883 inclusive. It was 13·79 for 1884 to 1888 inclusive, but 16·77 for 1889 to 1892 inclusive.

The average mortality rate for the whole order increased much more slowly, to wit: From 8·34, in 1879 to 1883 inclusive, to 8·93 in 1884 to 1888 inclusive, and to 9·84 in 1889 to 1892 inclusive.

The lower mortality of the order as a whole is doubtless closely connected with the fact that its membership grew 77 per cent. during 1878 to 1883 inclusive, 67·3 per cent. during the next five years, and 42·7 per cent. during 1889 to 1892 inclusive; but in the six States above referred to the growth in these three periods was respectively 88 per cent., 8·7 per cent., and 6·1 per cent.

The *Knights of Honor*, with headquarters at St. Louis, was founded in 1873, and is the second in age of the large fraternal orders. On Jan. 1, 1893, it had 127,073 members in 2,627 lodges, or 48 members in a lodge. Starting out with the admission of all healthy white males between 18 and 55 years of age, it reduced the limit to 50 in 1882, but continued to charge an equal assessment of 50 cents per $1,000 insurance at all ages up to 45 years of age at entry, and then graded it for each year, so that it was 75 cents at 49 years. But the young continued to withdraw, the membership to remain stationary or decline, and the mortality to rise, so at the supreme lodge session in June, 1892, the assessments were further graded so as to be 40 cents for those entering from 18 to 30, and then increasing for each year's age at entry until it reaches 50 cents at 34; 75 cents at 44; and $1 at 49. It was further ordered that new members should pay but one assessment a month the first six months and two a month for the next eighteen, or an average of twenty-one assessments a year for the first two years. The assessments on the other members had never exceeded twenty until 1892, when they were twenty-three. The adoption of these changes almost entirely stopped accessions from July to Nov., 1892, but during the next six months for which returns are accessible the membership had begun to grow again. There are 2,023 social non-beneficiary members, but no more such are to be admitted. The insurance policies are for $2,000, $1,000, and $500. Sick benefits are optional with the lodges. With a stationary membership since 1883 it is interesting to note how high the mortality may run. The rate has been as follows in the Knights of Honor:

Year.	Mortality.	Year.	Mortality.
1884	11·1	1889	12·7
1885	11·7	1890	14·3
1886	12·0	1891	15·5
1887	12·9	1892	16·3
1888	13·5		

The expenses of management, exclusive of lodge dues of $1.50 to $3 per $1,000, were 29·7 cents per $1,000 in 1892, and the total cost of insurance aside from lodge dues was $17.62. The cost has gradually increased to this from $13.10 in 1887.

The *Knights of Pythias, Endowment Rank*, organized in 1877 with headquarters at Chicago, had a membership Dec. 31, 1892, of 30,225, who were insured for from $1,000 to $5,000. The supreme lodge of the Knights of Pythias elects the board of control of the Endowment Rank, and allows only Knights of Pythias under 50 and over 21 years of age to join this insurance department. The assessments, payable monthly, are graded according to age at entry, and increase from 70 cents at 21 to $1 at 36 and $1.60 at 50 for each $1,000 insurance. The change to this plan from an equal assessment at all ages was made in 1884. Those who were members prior to the change are kept in a separate class on the books. In this class, which has received no new members since 1884, the mortality rose from 14·81 in 1886 to 24·18 in 1891. The mortality of the entire Endowment Rank has been remarkably constant, as appears from the following table:

Year.	Mortality.	Year.	Mortality.
1884	13·2	1889	12·10
1885	13·8	1890	12·60
1886	14·4	1891	14·40
1887	13·6	1892	13·90
1888	13·9		
Average	13·8	Average	13·25

The death-rate for the last four years has been less than for the previous five. As the insured belong to the local lodge anyway, the extra dues on account of insurance are small payments to maintain a local organization called a "section," which handles the insurance features. Members must pay monthly assessments without notice between the first and tenth of each month. The expenses, aside from small section dues, were only 42·7 cents per $1,000 insurance in 1892, and the total cost was $15. In 1888 the cost was nearly as much—$14.40.

The *Royal Arcanum*, founded in Boston in 1877, grew from 86,935 members, Dec. 31, 1888, to 137,189 members, Dec. 31, 1892, with $401,083,500 insurance in force, policies reading for either $3,000 or $1,500. The expenses of the central office in 1892 were only 23 cents per $1,000, and the entire disbursements, save local lodge dues, were $9.95. In 1887 they were $8.90. The mortality-rate, due in part to rapid growth in membership, has remained low.

ROYAL ARCANUM RATE OF MORTALITY.

Year.	Mortality.	Year.	Mortality.
1884	7·34	1889	8·1
1885	7·34	1890	9·0
1886	7·88	1891	9·0
1887	8·48	1892	8·9
1888	8·50		
Average	7·91	Average	8·75

It has risen from an average of 7·91 per 1,000 during 1884–88 to 8·75 during 1889–92. In 1883 the age limit was reduced to 55. The assessments are graded from $1 at entrance at the age of 21 to $1.38 at 30, $2.06 at 40, $3.26 at 50, and $4 at 54. No insurance lodges are allowed in the Gulf States, South Carolina, portions of Southeastern Georgia, and Western Kentucky and Tennessee. In this, as in many other fraternal orders, the lodges may pay the assessments on sick members and directly help in other ways the sick and disabled.

The *American Legion of Honor*, organized at Boston in 1878, grades its assessments on $1,000 from 40 cents for those entering under 30 to 84 cents at 50, the maximum age-limit. Policies which formerly ranged from $500 to $5,000 were reduced for new members to an extreme limit of $3,000 by the Supreme Council in Aug., 1893, to take effect Jan. 1, 1894. Weekly sick and disability benefits range from $2 on a $500 certificate to $12 on $3,000, and are limited to five weeks in a year and 20 per cent. of the certificate in a lifetime. There is an emergency fund of $500,000. Local council dues average $4 a member and $1.46 per $1,000 insurance, as the members carry an average of $2,726 insurance. The expenses of the central office in 1892 were 56 cents per $1,000, making the total local and central expenses $2.02, and the total costs were $19.40, aside from the local dues of $1.46, or, including said dues, $20.86. The mortality-rate has been as follows:

Year.	Mortality.	Year.	Mortality.
1884	9·3	1889	12·5
1885	10·8	1890	13·1
1886	10·0	1891	15·6
1887	11·8	1892	16·4
1888	13·1		
Average	11·0	Average	14·4

The membership was 57,005 at the close of 1884, 62,276 in 1888, and 60,554 at the end of 1892.

The *Knights and Ladies of Honor*, organized in 1878, with headquarters at Indianapolis, grew from 47,793 on Dec. 31, 1888, to 64,661 at the close of 1892, its mortality-rate meantime rising from 11·3 to 12·8. In 1890 there were 27,465 males and 29,201 females. The mortality was 13·14 for the males and 12·39 for the females. For all the years of the order ending with 1890 the death-rate for the males has been 11·71 and for the females 9·76. There are about one-sixth as many social as beneficiary or insurance members. Assessment rates vary according to age at entry from 30 cents for those 18 to 25 to 75 cents for those 49 to 50, 50 being the maximum limit since 1885, when it was 55. Like the United Friends and some others, this order levies its assessments only once a month. The entire cost, save from $1.50 to $2.50 per $1,000 for lodge dues, was $12.70 in 1890, $14 in 1891, and $13.60 in 1892.

The *Equitable Aid Union*, organized in 1879, having its headquarters at Columbus, Pa., and four-fifths of its membership in New York and Pennsylvania, grew from 14,182, on Dec. 31, 1884, to 37,460 at the close of 1892. It insures for any sum from $200 to $3,000, but is peculiar in that it grades the insurance to be paid. Thus the payment of a dollar at each assessment gives one who enters between 15 and 21 years of age $3,000, from 30 to 31 $2,500, from 40 to 41 $2,000, from 50 to 51 $1,500, from 60 to 61 $1,000, and 64 to 65 $800, other ages having corresponding ratios. The mortality was between 9 and 10·2 from 1884 to 1888. In 1889 it was 11·7; in 1890, 16; in 1891, 13·8; in 1892, 15·4. The entire cost per $1,000, save local lodge dues, was $16.10 in 1892.

The *National Union*, with headquarters at Toledo, O., is the only fraternal order that has adopted the so-called step-rate plan—i. e. that assesses the members according to age when assessed and not according to age at entry. Organized in 1881, it grew from 17,002 on Dec. 31, 1888, to 40,566 on Dec. 31, 1892. The cost of joining is from $5 to $7 for the charter members of a new council or lodge and from $8.50 to $12 for others. The average local council dues, which, with the initiation fees, provide for disability and the required aid to sick members, are from $1.15 to $2 per $1,000 of insurance. The national management expenses in 1892 were 35.6 cents per $1,000, and the entire cost, save council dues, was only $6.90. The mortality-rate has risen from 5·1 in 1888 to 6·9 in 1892. Insurance is given for from $1,000 to $5,000. For $1,000 the assessment rises from 20 cents at 20 years of age to 30 cents at 30, 40 cents at 40, 60 cents at 50, and 72 cents at 54, the upper age limit, which at first was 65. There was $101,168,000 insurance in force Dec. 31, 1892, and the average insurance per member was $3,152.11.

The *Catholic Benevolent Legion*, founded in 1881 with headquarters at Brooklyn, N. Y., and a present membership of 29,530, is like the *Catholic Mutual Benevolent Association*, with its 38,341 members at the close of 1892, and the *Catholic Knights of America*, with its 22,682 members, in that it confines its membership to Catholics. In the last-named society the members "must receive Holy Communion at least once a year, at Easter or thereabouts, under pain of forfeiture of all benefits." The mortality in all three of these Catholic orders was from 14·20 to 14·80 in 1892.

The *Modern Woodmen of America*, organized at Fulton, Ill., in 1883, and having on Dec. 31, 1892, 72,644 members, is somewhat different from any of the above. It not only confines its insurance to those between 18 and 45 and living in Michigan, Illinois, Iowa, Kansas, Wisconsin, Minnesota, the Dakotas, and Nebraska, but it refuses to insure in Chicago and Milwaukee, although two-thirds of the 9,000 members of the Royal League, organized also in 1883 and with a mortality in 1892 of only 5·4, live in Chicago.

The rate of assessment in the Modern Woodmen varies from 40 cents to 55 cents. Insurance for $1,000, $2,000, or $3,000 may be had by those under 41, and only $1,000 or $2,000 by those over 41. The death-rate of the order was 5 in 1891 and 7·8 in 1892. The expenses of management in 1892, aside from local dues, were $1.95, and the total cost, aside from local dues, was $7.30.

Space forbids a description of several other large fraternal orders like the *Knights of the Maccabees*, *Order of United Friends*, the *Independent Order of Foresters*, the *United Order of the Golden Cross*, and many others.

III. BUSINESS ASSESSMENT SOCIETIES.—These associations accumulate a much larger reserve fund than the fraternal societies, and, as has been remarked, use paid agents instead of fraternal lodges. The available assets exceeded the liabilities in 208 business assessment companies reported in the *Spectator Handbook* for 1893 by an amount equal to $11.90 on each $1,000 in force Jan. 1, 1893. In the case of 72 fraternal associations based on the lodge system the reserve amounted to 98 cents per $1,000. The reserve in the 25 old line companies reporting on this head to the Massachusetts Insurance Department was $269.57 per $1,000.

Some of the business assessment companies like the *Hartford Life and Annuity Insurance Company*, of Hartford, Conn., founded in 1880, provide only a limited reserve fund, not to exceed $10 on $1,000 insurance, or $1,000,000 in all, and guarantee maximum annual assessments for the first seven years of a policy. These assessments for the age of 30 at entrance would not exceed $27.42 the first year, $14.42 the third, and so gradually diminishing to $12.42 the seventh. For the age of 40 at entrance the maximum assessments for the first three years are respectively $29.98, $16.98, and $14.98, and at 50, $38.10, $25.10, and $23.10. After the seventh year assessments rise with advancing age according to mortality cost. The number of certificates in force rose from 24,357 at the close of 1888 to 38,390 four years later, while the total cost per $1,000 rose from $15 to $17.40. Of this, $4 went to expenses of management. The mortality-rate was 11·2 in 1888 and in 1892.

Another type of business assessment companies is the *Mutual Reserve Fund Life of New York*, organized in 1881. It assesses during the first years of a policy one-third more than the normal mortality cost for that age at entry, and thus provides a reserve fund which is used to reduce assessments in old age. Cash surrender values are also provided. The net assets on Jan. 1, 1893, amounted to $12.89 for each $1,000. The total cost of insurance rose from $13.70 in 1888 to $16.80 per $1,000 in 1892. Of this, $4.90 went to expenses. The membership grew from 47,693 on Dec. 31, 1888, to 72,342 four years later. The mortality was 9·61 per 1,000 policies in force in 1888 and 11·93 in 1892.

A third type of these assessment companies is represented by the *Fidelity Mutual Life Association*, of Philadelphia, founded in 1879. The probable annual costs are equated to level or equal annual rates, but, unlike an old line company, this assessment company has the legal right to increase the rates, if necessary. The expected rates for $1,000 and a surrender disability benefit of $500 at end of probable life are $15.06 at 25, $18.96 at 35, $25.88 at 45, and $40.71 at 55. The cost of all policies per $1,000 in 1892 was $17.60, of which $7.70 was expenses of management. In 1888 the total cost was $15.30. The mortality-rate was 6·93 in 1888 and 10·4 in 1892 in this association of 17,510 members.

Of the large business assessment associations the *Northwestern Masonic Aid*, of Chicago, started in 1874, furnished a sort of connecting link with fraternal associations, in that no one could be a member unless a Mason or be recommended by two Masons. On June 4, 1896, this restriction as to membership was abolished, the company reorganized, and an entirely new name adopted. On Dec. 31, 1892, 49,417 certificates were in force; its mortality-rate was 11·7 for every 1,000 certificates in force during the year; the entire cost per $1,000 was only $13.80, and the expenses of management $2.10. Aside from the *Knights Templars* and *Masons' Life Indemnity Association*, of Chicago, founded in 1884, it was the only large business association known to the writer that increased the rate of assessments with every few years' advance in age of the insured.

Another of the older assessment associations is the *Covenant Mutual Benefit Association*, of Galesburg Ill., founded in 1877, whose total cost of insurance was $15.10 per $1,000 in 1892. It had a membership of 42,317 Dec. 31, 1892, and a mortality that year of 11·2. In 1888 the mortality was 9·2.

The *Massachusetts Benefit Association*, which began business in Boston in 1879 and had 34,343 members at the close of 1892, had a total cost of $20.10 per $1,000 that year, of which $4.80 was expense of management. Its mortality-rate grew from 12·4 in 1888 to 16·6 in 1892.

If there be included in the insurance costs of the fraternal societies the lodge dues, initiation fees, and local medical examiner's fees, and the latter two items have been generally omitted in this article in case of that class of associations for lack of data, no great difference will be found in total costs of insurance between the best business assessment and fraternal orders. A slight superiority seems to lie with the best fraternal orders, while their members in some cases secure sick benefits in addition to insurance, and whatever mutual aid and pleasure there may be in the fraternal features.

Although the fraternal orders do not have a large reserve fund, they are wonderfully strengthened by the lodge feature, and boast that no fraternal life-insurance company based on the lodge system has ever failed, as have very many other systems. The cost per $1,000, after all allowance is made for local expenses, is from $9 to $21 in the several fraternal orders. In 13 of the 24 largest especially examined by the writer the cost in 1892, after full allowance for all local expenses, did not exceed $15 per $1,000 of mean insuranee. In 7 others it was between $15 and $18, and in 4 others between $18 and $21. The average expenditure per $1,000 for death-elaims and expenses of management in the 19 business assessment associations reporting to the Massachusetts insurance department for 1892 was $16.39. The disbursements in the 27 old line companies reporting at the same time, after deducting dividends to policy-holders, the net increase of surplus, this latter item being $3.67, and the amount spent to pay endowments and surrendered policies, the last two items amounting to $6.09, was $22.76 for each $1,000 of life and endowment policies. If we include in the insurance cost the amount spent for endowments and surrendered policies, the cost would be $28.85.

The friends of fraternal insurance point to the lower cost to the insured revealed in the above figures of the different insurance organizations as demonstrative of the economic superiority of the fraternal method. Their opponents, however, urge that the saving incident to self-management, which is the sole cause of that lower cost, is offset by the inadequacy of that management as compared with the direction of the business by trained officials employed solely to attend to the interests of the company. Losses incident to bad investments are said by the representatives of the old line companies to be an unavoidable element of danger in the self-managed associations, which, moreover, make no provision for the insured in the case of surrendered policies. To part of this it is replied that investments are an insignificant feature of fraternal associations, and a small one of other assessment companies, as shown above, and therefore high-salaried officials are not so necessary as in the old line companies. It is not the purpose of this article to pronounce upon the relative merits of these institutions, but merely to point out their inherent differences.

Assessment life-insurance societies should not be confounded with the assessment endowment orders. The fact that rapid growth keeps down the mortality and costs of insurance in assessment companies does not render them analogous to these endowment orders. In an assessment company, if there has been care in the selection of risks and such grading of assessments at different ages as to apportion equitably the cost of insurance or prove popular with the younger members, then the securing of as many new members as there are deaths from year to year ought to keep the average mortality as low at least as that of those over 20 years of age in the community at large. This in most sections of the country is under 15 per 1,000 lives. See LIFE-INSURANCE.

AUTHORITIES.—Reports of various State boards of life-insurance, especially Massachusetts, New York, New Hampshire, and Connecticut; the *Report for 1891* of the Connecticut Bureau of Labor Statistics; the *Pocket Chart of Co-operative Life, Accident, and Fraternal Associations* (Leavenworth Publishing Company, Detroit); the *Spectator Handbook of Life and Accident Insurance on the Assessment Plan* (the Spectator Company, New York): especially an article on the *History of Assessment Life Insurance*, by George D. Eldredge, in the edition for 1892; and the reports of the assessment and of the fraternal insurance congresses, and of the societies described. See FRIENDLY SOCIETIES.

EDWARD W. BEMIS.

Fraternities [from O. Fr. *fraternite* < Lat. *frater'nitas*, brotherhood, liter., brotherliness, deriv. of *fraternus*, brotherly, fraternal, deriv. of *frater*, brother]: voluntary associations of men for mutual benefit, benevolence, or pleasure. Such are the numerous secret and benevolent societies, and in a large sense the term may include the orders of the Church and the monastic and sacerdotal congregations, and even the orders of knighthood; also guilds, trades-unions, and the like. Among the laity of the Roman Catholic Church there are associations called fraternities, sodalities, confraternities, arch-confraternities, etc., designed for benevolent or devotional purposes. Some of these are very extensive and have many branches. See MASONRY, ODD FELLOWS, DRUIDS, GUILDS, COLLEGE FRATERNITIES, CLUBS, etc.

Fra'tres Arva'les, or **Arval Brethren**: a college of twelve priests said to have been established in ancient Rome by Romulus in honor of his nurse Acca Laurentia. The story is that Acca Laurentia having lost one of her twelve sons, Romulus, to console her, offered to take his place, and gave himself and his associates the title of Fratres Arvales. The term of office of the members of this order was for life, and office was not lost even by exile or imprisonment. Their duties consisted in celebrating an annual festival in honor of the gods who preside over the fields. They are said to have worn a crown made of ears of wheat and a white woolen wreath around their temples. See ARVAL BRETHREN.

Fratricel'li [partially Latinized form of Ital. *fratricelli*, liter., little brothers; plur. of *fraticello*, dimin. of *frate*, brother < Lat. *fra'ter*, brother]: (1) a name given to certain zealots of the thirteenth, fourteenth, and fifteenth centuries, who originally, influenced by the ideas on poverty of the Franciscans, adopted extravagantly ascetic habits, then later immoral practices and opposition to the papacy, going so far in these directions as to have community of wives and a pope of their own. They were condemned by Honorius IV. (1280), Nicholas IV. (1290), and Boniface VIII. (1296), and proceeded against by the Inquisition, which finally in the fifteenth century uprooted them. (2) The name is also given to the "Spirituals," a party among the Franciscans, who in the fourteenth century struggled for reform. They accepted the prophetical works of Joachim of Flore as inspired. Most of them after a time quietly returned to the order of St. Francis. (3) The name of the schismatics under Michael of Cesena, the general of the Franciscan order, who was joined by Lewis the Bavarian in their opposition to Pope John XXII. on account of his refusal to go their length in praise of poverty. Michael died unreconciled with the Church.

S. M. JACKSON.

Fraud [O. Fr. *fraude* : Ital. *fraude* < Lat. *fraus, fraudis*, fraud, deception]: in law, an act of intentional deception resulting in injury to another. Fraud of which the law takes cognizance has the effect to render voidable every transaction into which it enters as a constituent material element. But, as the essential qualification contained in this statement implies, it is not every perpetration of fraud that warrants legal interposition. In the sphere of morals all deceptive artifices for the purpose of misleading, every form of crafty imposition with the design of taking advantage of a person's confidence or credulity, are reprehensible as violations of the law of moral duty. But the enforcement of ethical obligations, simply on account of their rightful binding force upon the conscience, is, and must necessarily be for obvious reasons, altogether impracticable in courts of justice. Those forms of fraudulent practices, therefore, which legal methods are competent to examine and punish must be considered as included within the category of acts fraudulent in a moral sense, but not coextensive with it. And yet the precise line of demarkation can not be definitely drawn, though certain general principles may be stated upon which the distinction essentially depends. The first of these, and the most important, is that no dependence is to be placed upon the inherent quality of actions without regard to their natural or necessary consequences. The law considers the *results*, either actual or to be reasonably presumed, of every act concerning which question may arise as to its fraudulent character, and exerts its remedial agency only when injury to individuals or to the public welfare has, in fact, been occasioned or is to be naturally expected, and then only in behalf of the party whose interests may be prejudiced. Moreover, the injury must consist in an interference with some legal right or violation of some legal duty resulting in actual or probable pecuniary loss on the part of the person against whom the deception is practiced, or serious public detriment. It follows, therefore, as a deduction from this rule, that the same act, though done with intent to deceive, may sometimes be deemed fraudulent in law, and at other times not fraudulent, while in a moral aspect it would be fraudulent in all such cases. The distinction drawn in ordinary language between *deceive* and *defraud* serves to illustrate, in some degree, the difference between moral and legal fraud. Any adequate definition of fraud in law which will distinguish the character of actions considered simply in themselves is an impossibility. This fact has been so generally recognized by the courts that the attempt to frame such a definition has been pronounced contrary to the policy of the law. It is none the less true, however, that there are numerous classes of actions whose tendency to impair legal rights is so uniform and natural that they may be generally pronounced fraudulent when considered simply in themselves. But these can be more advantageously enumerated than defined. Another characteristic of acts deemed fraudulent in law is an intent, either actual or presumed, to occasion harm or damage to another. The principle is the same as in morals—that a wrongful purpose is necessary to render a deceptive act culpable. In a large class of cases, however, a fraudulent intent is presumed from the nature of the transaction. Hence arises the doctrine of constructive fraud, to be hereafter noticed. Actual fraud, on the contrary, consists in intentional deception, artifice, or concealment, with the view or expectation that a person will be misled, and the actual misleading him to his injury. Both actual fraud and constructive fraud are, with but few exceptions, within the cognizance of courts either of law or courts of equity under the division of jurisdiction which exists in the English and American systems of jurisprudence. (See COMMON LAW, EQUITY.) The chief exception to equity jurisdiction in questions of fraud is in relation to wills. Wills of personal estate are considered in probate or surrogate courts—those of real property in the common-law tribunals. But the general jurisdiction of equity over the subject of fraud is very comprehensive, and cases of constructive fraud particularly are much more commonly considered in equity than at law. The legal remedy consists merely of an award of damages to the injured party, while the modes of equitable relief, which admit the setting aside of a fraudulent transaction or the enforcement of the specific performance of an agreement, are oftentimes much more beneficial and desirable. It has been said that equity would presume the existence of fraud upon slighter evidence than would be required in courts of law, but this assertion is hardly sustainable. The more extensive jurisdiction of equity in cases of fraud is to be attributed especially to the superiority of its remedial processes. It will therefore be most expedient in the further consideration of this subject to state only the body of principles which have been established in equity, since they not only include those maintained at law, but are still more extensive in scope.

I. *Actual Fraud.*—Cases of this kind may be divided into two principal classes. The first class includes those forms of fraud which occur between parties who are under no legal incapacity, and who are in no mutual, confidential, or fiduciary relations with each other. The second class of frauds embraces those whose origin is chiefly attributable to the mental infirmity or legal disability of the persons injured, by reason of which imposition and deception may be more readily practiced than is usually possible.

1. In the first class of cases it is only necessary to have regard to the conduct of those committing the fraud and the nature of the transaction in which it occurs, without reference to the peculiar condition of those injured. The fraud perpetrated may be either, as it is termed in Latin phrase, *suggestio falsi*, the statement of an untruth, an open misrepresentation, or *suppressio veri*, concealment or suppression of the truth.

(*a*) *Suggestio Falsi.*—There are various elements necessary in an actual misrepresentation in order that it may furnish a ground of action. (1) The falsity of the statement must be known to the party making it, or else he must be justly chargeable with the possession of such knowledge. If he is perfectly honest in his belief of the truth of his representation, and is guilty of no imprudence or negligence in making the statement, he is not answerable for any injurious consequences that may result on the theory of fraud, though the transaction may perhaps be set aside on the ground of mistake. (See MISTAKE.) If his conviction was formed upon evidence sufficient to satisfy a reasonable mind, he would be justified in asserting as a fact what he properly deemed to be such. But if, while aware that his opinion is founded upon mere rumor, conjecture, or trivial testimony, he states it as matter of positive knowledge on his part, in order to induce others to act upon the faith of it, or with good reason to suppose that they will so act, he is deemed as culpable in law as if he actually knew that he was giving erroneous information. The statement, under such circumstances, of what one does not know to be true is said to be as unjustifiable as the statement of what one actually knows to be false. In like manner, if the means of information are peculiarly accessible to the person making the representation, and he is aware that his assertion will be acted upon, his failure to acquire the necessary information may constitute a fraud. (2) The statement must be made with intent to influence some person's action, or upon the understanding or reasonable belief that such a result is likely to ensue. In cases of this latter kind the nature of the concomitant circumstances would be sufficient evidence of fraudulent intent. If erroneous assertions be simply made in casual conversation as matter of gossip or common interest, or if they be stated merely as opinions, or if no transactions are contemplated or known which could be affected by confidence in the statements, any resulting deception and loss constitutes no legal injury. (3) The misrepresentation must be as to some *material* fact constituting an inducement to the act or omission of the other party. The test of materiality is whether, if the party had known the truth, he would have engaged in the transaction by which loss was sustained. (4) The person to whom the misrepresentation was made must rely upon it as a motive to his action, and must be justified in such reliance upon grounds of ordinary prudence and caution. If, notwithstanding the false statements, the person to whom they are made relies entirely upon his own judgment and sagacity, he will not be permitted to maintain an action on the ground that he was deceived, and sustained injury in consequence. When persons deal at "arms' length," as it is termed, there is no room for one to allege deceit against the other. Moreover, if reliance upon the false representations were an act of folly, such as no sensible man would have been guilty of, the courts will afford no relief. If the fact which is misstated is plainly within observation, and one acts upon faith in the falsehood, rejecting the evidence of his own senses, his injury is the result of his own wrong, and not of another's. But if some examination be necessary to detect the error, and the party to whom the representation is made acts with ordinary prudence, confidence in the representation will not be unreasonable, and the deceiver will be responsible. Moreover, if mere belief be stated as belief, opinion as opinion, or supposition as supposition, no person is justified in acting upon it as if it were an expression of actual truth, and if he does must suffer the consequences. So if a person knows a representation made to him to be false, such knowledge will prevent any allegation on his part of fraudulent deception. (5) The party deceived must have sustained an injury. Wrong without loss no more gives a cause of action than loss without wrong. Fraud and damage must coexist as cause and effect. This rule is, however, more formal than substantial, as injury may be presumed so far at least as to entitle one to nominal damages.

(b) *Suppressio Veri.*—A concealment of the truth, by reason of which injury is occasioned, is not to be deemed fraudulent under all circumstances, but only where a person is bound in conscience and duty to make disclosure in order to prevent undue advantage being taken of another. If a vendor knows that there are latent defects in his goods, of which the buyer is not aware, and that the consummation of the intended purchase would not be effected were it not for such a misunderstanding, and the buyer can not discover the defects by ordinary observation, a failure to remove the delusion is equivalent to an express misrepresentation; but if no confidence is reposed in the person making the concealment, the other party preferring to trust to his own judgment, no wrong is done by a failure to reveal a secret source of mistake. And if a defect be patent and readily discoverable upon examination, the maxim of *caveat emptor* will apply, and a seller will be under no obligation to protect a purchaser who by his own imprudence fails to profit by opportunities of discovery within his reach. There are, moreover, cases in which a delicate sense of moral duty would prompt to disclosure, while no similar obligation would be imposed in law. If, for instance, a man knowing of the existence of a valuable mine upon another's land, of which the latter was ignorant, should buy the property without mentioning this important fact, his action would be deemed justifiable. The same view would be taken in many forms of speculation where persons enjoying peculiar facilities for acquiring information about the value of property buy or sell without communicating knowledge which would materially modify the terms of the negotiation. In contracts of certain kinds, however, the fullest information and good faith is requisite, or the contract will be invalid. This is true in cases of suretyship and insurance. Dealings between parties between whom fiduciary relations subsist must also be marked by the most complete confidence and frankness. For fraudulent warranties, see WARRANTY.

2. The second class of cases of actual fraud includes deceptions rendered possible by mental infirmity or want of ordinary discretion on the part of those injured. Persons under such disability are incapable of giving that free and rational consent which is necessary to render their acts valid. The mental aberration may be so complete as entirely to prevent a legal transaction, as in cases of lunacy, idiocy, or dementia, or there may be only such a degree of weakness of intellect that undue influence may be more or less readily exercised by designing persons. In instances of this latter kind dealings which can be proved to have been conducted with entire fairness will be sustained, but they will be subjected to a careful scrutiny, and the burden of proof may be cast upon the person profiting by the transaction to show its fairness. For similar reasons, if there be such a degree of drunkenness as to utterly deprive a person of his reason and understanding, dealings with him to his disadvantage will be deemed fraudulent unless there is clear evidence to the contrary. Acts of infants and their contracts, except for necessaries, are judged voidable on account of their lack of reasonable discernment and discretion. Similar protection is afforded to persons under duress or in such extreme necessity that undue advantage is taken of them.

II. *Constructive Fraud.*—The peculiarity of this is that no intent to defraud necessarily exists, but is presumed as an inference of law. Cases under this head may be divided into three classes. The first includes contracts which are deemed fraudulent as contrary to public policy; the second, injurious acts which arise from some peculiar confidential or fiduciary relation between the parties; while the third embraces transactions which operate substantially as frauds upon the rights of third persons.

1. The principal varieties of contracts invalid, as in contravention of public policy, are—(1) Marriage-brokage contracts, by which a person agrees to give another a reward if he will negotiate a marriage for him. Money paid on such a contract may be recovered. (2) Rewards promised for influencing another person to make a will in a particular manner. (3) Contracts in general restraint of marriage, because they are detrimental to the general welfare of society, which is promoted by suitable marriages. The restraint is "general" when a person is bound not to marry at all, or to marry nobody except a particular person who is under no corresponding obligation. (4) Contracts in general restraint of trade, as tending to promote monopolies and discourage business industry and enterprise. (5) Various other contracts founded upon violations of public trust and confidence, as e. g. agreements to procure the passage of legislative acts by unjustifiable means, contracts for the buying and selling of public offices, agreements for the composition of a felony, wager contracts, usurious contracts, etc. In like manner, contracts founded upon corrupt considerations or moral turpitude are void. Of this sort are all agreements given to procure the commission of a public crime, or the omission of a public duty, or an offense against chastity.

2. In cases of constructive fraud arising from some confidential or fiduciary relation between the parties the peculiar nature of the wrong lies in its being an abuse of confidence lawfully reposed. Oftentimes there is some actual deceit or imposition practiced, but this is not necessary in order that the transaction may be invalidated. A wrongful intent may be presumed from the want of that perfect openness and fairness which the relation demands. The relations of the parties may be of various kinds: (1) *Parent and Child.*—Conveyances by children to parents are subjected to careful scrutiny on account of the danger that they may have been procured by an undue exercise of parental authority. Even after a child has attained his majority, the presumption is that parental influence continues for at least some short period, and mutual dealings to the child's detriment must be proved to have been attended with the utmost good faith or they will not be sustained. (2) *Guardian and Ward.*—A guardian will not be permitted to reap any advantage from dealings with his ward until the influence which his position of authority gives him has entirely ceased. A settlement or contract favorable to the guardian immediately after the ward reaches his majority is looked upon with great distrust. (See GUARDIAN.) (3) *Attorney and Client.*—In any transactions to which this relation gives rise it is a general rule that the attorney shall not gain any advantage to himself at the expense of his client beyond the amount of his just and fair professional compensation. (4) *Physician and Patient.*—Similar principles prevail in reference to this special relation. (5) *Trustee and Cestui que trust.*—A trustee is bound not to place himself in any position antagonistic to the fulfillment of the duties of his trust, and can derive no personal benefit to himself in the discharge of such duties. A purchase by a trustee from his *cestui que trust*, even though it can not be proved to be unfair, may be set aside at the latter's desire. It is thought wise to *disable* him from dealing with the beneficiary in order that he may be under no temptation to profit by a breach of trust. (6) Other fiduciary relations, as between principal and agent, partners, creditor and surety, etc., are governed by similar principles.

3. Transactions deemed fraudulent because they unwarrantably compromit the rights and interests of third parties afford ground for equitable relief on account of their pernicious tendency, although the persons immediately concerned may have acted freely and willingly. But the third persons who are injured must stand in some peculiar relation with one of the immediate parties to the transaction, and the injury must be dependent upon this relation. There are several classes of cases to which this doctrine is applicable. (1) Relief will be granted in what are called catching bargains with heirs or expectants during the life of their parents or other ancestors. By bargains of this kind are meant agreements to purchase the expected interest for a present sum, and by such transactions, of which the ancestor is ignorant, he is deceived into leaving his property to other persons than those to whom he believed it would pass. Sales of expectancies are, in general, only made by those who are improvident and necessitous, and will never be sustained unless the purchaser can establish that there was no fraud, but that a fair and adequate consideration was given. Upon the same principle, *post-obit* bonds given by heirs and expectants are set aside. These are securities promising, for a present loan, to pay a larger sum, exceeding the legal rate of interest, upon the death of the person from whom the expectancy is to be received. (2) Conveyances to defraud a party to a marriage are constructive frauds, as if either party to a marriage contract should enter into an agreement with a third person by which the other party would be defrauded of reasonable expectations. (3) Conveyances to de-

fraud creditors and purchasers are of the same character. These are considered under the head of FRAUDULENT CONVEYANCE.

Only an enumeration of the more important classes of fraudulent devices can be attempted. Frauds, as has been said, are infinitely various. But this general *résumé* of the leading principles appertaining to the subject shows that the jurisdiction of the courts in cases of this nature is very comprehensive and very salutary. The advanced and enlightened doctrines of equity are in furtherance of the highest practicable standard of morality which human tribunals can be deemed capable of adequately enforcing.

T. W. DWIGHT.

Frauds, Statute of: a celebrated statute, originally enacted in England in the reign of Charles II. (1677), for the prevention of frauds and perjuries, requiring the use of written instruments in many classes of contracts and in the various modes of transfer of different interests in property. The imperfection and danger of oral testimony as an adequate means of proof of the nature of past transactions, especially when valuable interests are at stake, renders this statute one of the most salutary measures of legislation in English jurisprudence, and its importance has been so fully recognized in the U. S. that it has been substantially re-enacted in nearly every State, and in some of them its provisions have been made still more comprehensive and stringent. The difficulty of ascertaining the exact nature of certain agreements into which parties have entered, if dependence were to be placed chiefly or entirely upon the vague and unsatisfactory remembrance of witnesses, would prove a very serious interference with the proper administration of justice, and would afford an opportunity and a powerful temptation to unprincipled men to fabricate evidence in the furtherance of fraudulent designs. The chances of detection would be too meager to be of any practical value. Where discrepancies in testimony can be attributed to a natural forgetfulness, rather than to any wrongful intent, discrimination between honest and dishonest claims becomes well-nigh impossible. Moreover, a very slight change in the terms of a stipulation has oftentimes a serious influence upon the interests of those whose rights are in controversy, and witnesses with every intention to be accurate would unavoidably differ in their accounts of the same occurrence. Writing exhibits the precise nature of an agreement, unaffected by the contrariety of testimony, or by the mental reservations of the parties concerned. Written documents, moreover, remain as a perpetual memorial of the events which they record, while the removal of witnesses by death would not unfrequently render it impossible to secure the requisite oral testimony if this alone were necessary to be introduced. The adequate protection of private rights, therefore, and the furtherance of the remedial operations of the courts render the requirement of written evidence in many cases a necessity.

The scope of the statute is very comprehensive. It includes within its provisions the subject-matter of a variety of contracts, and also transfers of land by way of devise. Certain sections require writing in the creation, assignment, or surrender of leases; others apply to devises; others to declarations and assignments of trusts (but these will be considered more conveniently under the specific topics LEASE, WILL, and TRUSTS, to which reference may be made). The sections which it will be most desirable to examine in this connection are those which most particularly affect the law of ordinary contracts. These are the fourth and the seventeenth of the original English statute. By the fourth section it is provided that "no action shall be brought (1) whereby to charge any executor or administrator upon any special promise to answer damages out of his own estate; (2) or whereby to charge the defendant upon any special promise to answer for the debt, default, or miscarriage of another person; (3) or to charge any person upon any agreement made upon consideration of marriage; (4) or upon any contract for the sale of lands, tenements, or hereditaments, or any interest in or concerning them; (5) or upon any agreement that is not to be performed within the space of one year from the making thereof; unless the agreement upon which such action shall be brought, or some memorandum or note thereof, shall be in writing and signed by the party to be charged therewith, or some other person thereunto by him lawfully authorized." The requirement of signing which the statute imposes is sufficiently complied with if the name be written in any part of the instrument for the purpose of authenticating it. In some of the American States, however, the language of the statute is not "signed," but "subscribed"; and this renders it necessary that the signature be at the end of the writing. The form of the instrument is immaterial. The object is to secure correct and adequate documentary evidence of the intent and agreement of the parties; and it is therefore sufficient if the stipulations which are concurred in are embodied in separate letters or in distinct instruments, provided the contents of each have so intimate a connection with, and so evident a reference to, the matter contained in the others that the entire contract is manifestly ascertainable only from a comparison of all the writings. But the whole agreement must be deducible from the connected instruments, without its being necessary to supplement them by parol declarations.

The statement of the consideration of the contract is required in England and some of the States, but in others the consideration may be proved by extraneous evidence. The statute, it will be noticed, provides that the signature of a properly authorized agent will be equally valid with that of the party actually interested. Such authority may be given either orally or by writing, provided the act to be done does not require the execution of a deed or other conveyance. Where the conveyance must be under seal, so must the authority be. A single person may act as agent for both parties to the contract, as, for instance, an auctioneer, or broker, whose signature will be binding upon either vendor or purchaser. The signature to the instrument may be written either in ink or in pencil, or will be sufficient if printed, if this mode of authentication is usually adopted by the person to be charged or is sufficiently authorized by him.

Under the first clause of the section it has been decided that if an executor or administrator give bonds for the faithful discharge of his duty, a subsequent promise to pay a debt of the testator will be construed as charging the assets derived from the testator's estate, and not the representative's own property, so that no writing will be necessary. A promise made by an administrator before letters of administration are issued to him from which he derives his authority is also not within the requirement of the statute. The second clause, applying to promises "to answer for the debt, default, or miscarriage of another," necessitates the use of writing in all contracts of guaranty. (For the rules upon this subject see GUARANTY.) The third clause, referring to "promises made in consideration of marriage," is held to apply to promises of settlement, advancement, or other provision in anticipation of marriage, but not to promises to marry, which may therefore be made orally, unless they fall within the fifth clause, referred to below. The written promise, to be enforceable, must be effectually operative in inducing the claimant under it to enter into the marriage contract. Hence when a father made a written promise of advancement to his daughter in case she was married to a particular person, but the intended husband did not know of the promise, nor act upon the faith of it in marrying her, he was not allowed to enforce the promise. The fourth clause, concerning contracts for the sale of real estate or any interest therein, does not require writing in the sale of crops or annual industrial products. If, however, the sale is of standing trees or products not the result of annual cultivation, the better opinion is that the case falls within the statute. When both land and its products are sold to the same individual, the entire contract must be in writing. A mere license to use land does not create any legal interest in the property, and need not be written to be valid, though in such case it is in general revocable at will. The fifth clause relates to "agreements that are not to be performed within the space of one year from the making thereof." Under this provision it is not necessary that an oral agreement be actually fulfilled within the limits of a year from the time when it was made in order to be sustainable, but only that it be capable of fulfillment within that period in the contemplation of the parties when they enter into the stipulations. The actual result may show that the anticipations were unrealized, but the validity of the engagement, though it be unwritten, is in nowise impaired.

The other section of the statute which especially relates to ordinary contracts—viz., the seventeenth—provides that "no contracts for the sale of any goods, wares, or merchandise for the price of £10 sterling or upward, shall be allowed to be good except the buyer shall accept part of the goods so sold, and actually receive the same, or give something in earnest to bind the bargain or in part payment, or that some note or memorandum in writing of the said bargain be made and signed by the parties to be charged by such contract, or their agents thereunto lawfully authorized." In the statutes of the American States the principal alteration made in these terms is by the specification of a different sum of money. The sum generally established is fifty dollars, but in some of the States it is thirty dollars or forty dollars. This section is distinguished from any others contained in the statute by authorizing various modes of giving validity to contracts besides the single method of writing. This diversity is established on account of the comparatively greater frequency with which contracts for the sale of goods are made, and on account of the great inconvenience that would ensue if formal and precise agreements were always necessary to be prepared to effectuate such ordinary transfers. There is, however, this disadvantage—that by dispensing with the requirement of writing in every case the difficulty of proving the terms of many contracts is much increased; but the greater facility with which business operations may be conducted is deemed amply compensatory for this defect. The first mode mentioned by which the sale may be rendered valid is by delivery and acceptance of the goods. Both these prerequisites are absolutely essential in the absence of writing or part payment. A mere expression of final agreement to the terms of the sale of specific chattels is not, as in ordinary transactions of the kind, sufficient to impose a liability upon the purchaser. The delivery may be either actual or constructive. Constructive delivery occurs when means of readily taking possession of the goods are given to the purchaser, which he may exercise in exclusion of the vendor's claim. Thus the delivery of a key giving access to a warehouse in which the merchandise is deposited is equivalent to a complete transfer of possession. The same purpose is accomplished by giving an order upon a bailee of the goods, which the bailee accepts. The delivery of an integral part of the articles sold is virtually a delivery of the whole. Acceptance on the part of the buyer must be manifested by a suitable act. It is thought by some that there are two acceptances—one, to satisfy the statute of frauds; the other, to preclude the purchaser from objecting that the goods did not correspond with the statute. Accordingly, the former acceptance might have been made, while the purchaser might be still able to return the goods, on the special ground that they did not comply with the contract. As a second method of binding the bargain, earnest may be given. Earnest is a token or pledge passing between the parties by way of evidence or ratification of the sale. The article given must have some appreciable value, even though this be quite insignificant. A chip or pebble would be inadequate, while a cent or a ring would suffice. The effect of earnest is to impose upon the seller an obligation to retain the goods subject to the demand of the purchaser; but the latter must pay the purchase-money upon obtaining delivery. The giving of earnest was a common practice in the early history of English law, but it has now fallen into general desuetude. Thirdly, part payment may be made. This has the same effect as the giving of earnest. There must be an actual transfer of a portion of the price agreed upon, since the liquidation of a former debt as a part of the consideration for the sale will not be sufficient. Fourthly, the agreement or some note or memorandum thereof must be in writing. The principles applying when this mode of authenticating the contract is adopted have been already considered.

It has been much questioned whether executory contracts for the sale of goods which were not in existence in the form contemplated by the parties at the time when the agreement was made are within the statute of frauds. It is now, however, generally settled, contrary to the rule formerly prevailing, that such contracts, if they have reference substantially to a sale of chattels, even though these must necessarily be fabricated out of certain materials before delivery can be made, are within the statute, and must consequently be in writing. But if the contract is essentially for the performance of work and labor about certain chattels, the requirements of the statute have no application.

Courts of equity, as well as courts of law, are bound to comply with and enforce the provisions of the statute of frauds. But where strict compliance would produce hardship and injustice, as sometimes proves to be the case, courts of equity have power to grant special relief, even though the precise letter of the law be violated. Thus if a contract which ought to have been in writing is fully set forth in the bill of the plaintiff in equity, and is confessed by the answer of the defendant, it will be enforced, since there can be no danger of the commission of fraud, and the defendant may be deemed to have waived his right of defense under the statute by failing to urge it. If, however, he adduces and maintains such a defense, it will be effectual to protect him against the plaintiff's claim. In like manner, specific performance of an oral contract will be decreed if it has been partly carried into execution. This principle is established because a different rule would enable fraudulent designs to be consummated, which it was the design of the statute to prohibit. But the part performance must be something more than the part payment of the price. Moreover, the act must be done solely with a view to the performance of the agreement. An illustration of such a part performance would be the act of making improvements upon land by a purchaser in pursuance of an oral contract for its purchase. A still further exception to the statute is where an agreement is intended by the parties to be reduced to writing in the appropriate manner, but this is prevented by the fraud or cunning shrewdness of one of the parties. Equity follows the spirit of the statute by preventing the commission of fraud wherever it is possible. See SPECIFIC PERFORMANCE. T. W. DWIGHT.

Fraudulent Conveyance: a conveyance the object, tendency, or effect of which is to defraud another not a party to such conveyance, or the intent of which is to avoid some debt or duty due by or incumbent on the party making it. Such conveyances are declared invalid by two famous English statutes, which have been re-enacted throughout the U. S. with substantially the same provisions. By one of these, passed in the thirteenth year of the reign of Queen Elizabeth (1571), and commonly referred to as the statute 13 Eliz., ch. 5, all fraudulent conveyances, gifts, or alienations of lands or goods whereby *creditors* might be in any wise disturbed, hindered, delayed, or defrauded of their just rights, are rendered utterly void; but the act does not extend to any estate or interest in lands *on good consideration*, and *bona fide* conveyed to any person not having notice of such fraud.

The points deserving particular attention in the provisions of this act are that it applies to chattels as well as to lands; that it protects only the interests of defrauded *creditors*; and that the exception refers only to *lands* conveyed upon "good consideration" *and* to a "*bona fide*" grantee. Both these latter characteristics are necessary to the conveyance to render it not fraudulent, and if there were only a "good consideration" *or* a "bona fide" transfer, the privilege of the exception would not be available, and creditors might impeach and overthrow the conveyance. By a good consideration, as the phrase is here used, is intended every kind of consideration known to the law, whether it belong to the class more specifically termed "good" or meritorious considerations, by which is meant motives of natural affection founded on relationship, or to the class known as valuable considerations, which include every mode of pecuniary return for a promise or grant. If, therefore, there be an actual fraudulent intent in making a conveyance, and this be known to the grantee, so that he becomes a participant in the wrong committed, it is immaterial, as regards the validity of the conveyance, that there was an adequate consideration, even of a pecuniary nature. The fraud would be fatal. But if the purchaser for a valuable consideration acted innocently, under the influence of an honest belief that the conveyance was unobjectionable, his right to the property would be superior to the claims of creditors. But questions of most importance and difficulty have arisen under the statute in regard to the effect of voluntary conveyances, by which is meant, in a legal sense, those which are intended as mere gifts or are made merely upon meritorious considerations of natural love and affection. The principle is maintained in law, as well as in the sphere of morals, that "a man must be just before he is generous"; and if one under a burden of indebtedness disposes of the property, which ought to be used in satisfying the claims of his creditors, in gratuities to his relatives or friends, a fraudulent intent is imputed to him as a necessary presumption, without the need of positive proof. But if the property transferred were in no way essential to the maintenance of the debtor's full solvency, the conveyance would, according to the prevailing opinion, be sustained. A person, for instance, might possess ample means to discharge all his obligations after bestowing a portion of his property in gifts upon others, and the conveyance would then be deemed valid, as involving no reasonable implication of dishonest intention. To impose any prohibition upon those whose debts bear but a small proportion to their actual resources, preventing them from disposing of at least a part of the surplus in voluntary conveyances if they so desired, would be manifestly unjust, since the rights of creditors would receive, without such a rule, full and adequate protection, to which alone they are entitled. It has been decided in England that a voluntary conveyance is not fraudulent unless it transfers property which might be taken in execution for the payment of debts, since otherwise creditors receive no injury. This doctrine has been somewhat controverted in the U. S., though it has nevertheless been generally sustained. However, if the law of the State permits property which can not be taken on an *execution* to be seized by some other process for the payment of debts, it would be a fraud upon creditors to withdraw it from their reach. When the gratuitous disposition of property is injurious to subsequent rather than antecedent creditors, the presumption of a fraudulent purpose is not so readily entertained. If it were proved that such an act formed a part of a preconceived scheme to incur indebtedness after the means of payment had been bestowed upon others, the conveyance would justly be invalidated. But in the absence of such evidence no conclusion could be fairly drawn, from the mere circumstance of a gift to a wife, child, or friend which was not at the time prejudicial to the interests of any other persons, that the transfer was made in the prosecution of a fraudulent purpose.

The second statute against fraudulent conveyances is known as the statute 27 Eliz., ch. 4, enacted in 1585. It enacts that the conveyance of any interest in lands for the intent and purpose to defraud and deceive subsequent *bona fide purchasers* of the lands for a good consideration shall be utterly void. This act differs from the previous one in applying simply to lands, and in protecting the interests of purchasers instead of creditors; but it contains similar provisions declaring the validity of any previous conveyance if it be upon valuable consideration and to a *bona fide* purchaser. It has been adjudged in England, in the interpretation of this statute, that if the previous conveyance be voluntary, it is void as to a subsequent purchaser, even though he had notice before he received his deed that such a conveyance had been made. This doctrine has been generally rejected in the courts of the U. S. as inequitable, and the principle adopted that the receipt of notice gives a person intending to purchase ample opportunity to protect his own interests, and if he is guilty of imprudence in accepting the conveyance he ought to receive no assistance from the courts. This seems the better doctrine. Under both statutes voluntary conveyances are never set aside as between the immediate parties, but only in favor of creditors or purchasers.

T. W. DWIGHT.

Frauenburg, frow'en-boorkh: a town of Prussia; province of East Prussia; on the Frische Haff; 42 miles S. W. of Königsberg (see map of German Empire, ref. 1–J). It is the seat of the Roman Catholic Bishop of Ermeland, and has a curious cathedral with six towers, which in former times served at once as a fortress and as a water-work. The machinery intended for the latter purpose and contained in one of the towers is said to have been constructed by Copernicus, who was a native of Frauenburg. Pop. (1890) 2,458.

Fraunhofer, frown'hō-fer, JOSEPH, von: mathematician; b. at Straubing, Bavaria, Mar. 6, 1787; was brought up to his father's trade as a glass-worker, but studied optics, astronomy, and mathematics, and in 1806 became a director of the mathematical institute of Munich. In 1815 he observed, measured, and described with admirable fidelity the dark lines of the solar spectrum, called Fraunhofer's lines, first noticed by Wollaston in 1802 (see SPECTROSCOPE), and in 1817 was admitted to the Academy of Sciences, Munich. He was a partner in the manufactory of optical apparatus at Benedict-Beuren, which in 1819 was removed to Munich. He made many improvements in fine glass-making, in dioptric instruments, and in the machinery for the manufacture and finishing of lenses; made the noble refracting telescope of the Dorpat Observatory; in 1823 became professor and director of the Cabinet of Physics, Munich. D. at Munich, June 7, 1826.

Fraxin, or **Paviin**, pā'vi-in: a fluorescent glucoside ($C_{16}H_{18}O_{10}$) found in the bark of the common ash-tree (*Fraxinus excelsior*), in the horse-chestnut with æsculin, and in some other barks. It is sparingly soluble in cold water. Its very dilute solution exhibits by daylight a beautiful blue-green fluorescence. Dilute sulphuric acid converts it into fraxetin and glucose.

Fraxinel'la: the *Dictamnus albus*, an aromatic European herb sometimes raised in gardens. It abounds in volatile oil to such an extent that in warm, still weather the air becomes charged with an inflammable vapor. This phenomenon is best shown by inclosing the plant in a box or Wardian case. The plant belongs to the family *Rutaceæ*.

Frayssinous, frā'sēē'noo', DENIS ANTOINE LUC, Count de: prelate and author; b. of humble parentage in the department of Aveyron, France, May 9, 1765; d. there Dec. 12, 1841. He was educated in the seminaries of Rodez and St.-Sulpice, Paris, and was ordained a priest in 1789. From 1804 his "conferences" in the Church of St.-Sulpice began to attract general attention, but on account of his open opposition to the ecclesiastical policy of Napoleon his lectures were prohibited in 1810, and next year he retired from Paris. He returned with the restoration, was made almoner to Louis XVIII., a count and peer of France, and under Charles X. he became Minister of Ecclesiastical Affairs. After the Revolution he retired to his native place. He published, in 1818, *Vrais principes de l'Église Gallicane* and *Sur l'indifference en matière religieuse.* His "conferences" were collected and published in 1825 under the title *Défense du Christianisme.* See Henrion's *Vie de Mgr. Frayssinous* (Paris, 1842).

Frazee', JOHN: sculptor; b. in Rahway, N. J., July 18, 1790; commenced business as a stone-cutter in New Brunswick 1814; later opened a marble-yard on Broadway, New York. From 1819 till 1823 his work was chiefly in mantelpieces and monuments. His first bust, a head of John Wells, was executed in 1824. He subsequently made busts of Chief Justice Marshall, Dr. Bowditch, Daniel Webster, Gen. Jackson, John Jay, Judges Story and Prescott. The marble building in New York, originally the custom-house but used as the U. S. sub-treasury since 1862, bears his name inscribed as the architect. D. at New Bedford, Mass., Mar. 3, 1852.

Fraziers (Frayzers) Farm, Battle of, known also as the battle of Glendale, Newmarket Road, Nelson's Farm, and Charles City Cross-roads: an engagement of the civil war in the U. S. June 30, 1862. After the battle of GAINES MILL (*q. v.*) McClellan gave up his position along the Chickahominy and fell back to the James river. Magruder, who commanded the troops in front of Richmond and S. of the Chickahominy, moved forward and made the attacks at ALLEN'S FARM and SAVAGE'S STATION (*qq. v.*) June 29, where he was held in check by Sumner and Franklin, and the Union army crossed White Oak Swamp and destroyed White Oak Bridge. Gens. Richardson and W. F. Smith took a position on the south side of the stream to defend the crossing, and the divisions of Slocum, Kearny, McCall, and Hooker, in the order named from right to left with Sedgwick in reserve, formed a line facing nearly west, near Charles City Cross-road, the line being an irregular one with a re-entrant between Hooker and McCall and a salient at Kearny. Porter and Sykes marched on and occupied Malvern Hill. Gen. Jackson, crossing the Chickahominy at Grapevine Bridge, followed the Union troops, and at about 11 A. M., June 30, attempted to force a crossing at White Oak Bridge, but was held back during the rest of the day, principally by artillery. Longstreet and A. P. Hill crossed the Chickahominy at New Bridge early in the morning of the 29th, and marching by the west of White Oak Swamp took the Darbytown Road to strike the flank of McClellan's column near the junction of the Charles City and Quaker Roads. Halting within 2 miles of this point in the evening of the 29th, they advanced again in the morning of the 30th, and took up a position with a view to attacking simultaneously with Jackson and Huger, the latter of whom had come down the Charles City Road. An artillery action at about 2.30 P. M. between Huger and Slocum led Longstreet to make his attack, which he did with his own division, holding Hill's in reserve to pursue the Union troops after the column was cut in two and beaten. Longstreet's attack struck McCall's left and drove it back, but, new troops coming up, the line was re-established. Desperate fighting took place here and in front of Kearny; the

Confederates gained some ground, but no material advantage, and after putting in Hill's division were held in check until night. They were foiled in all their plans. During the day the reserve artillery, the wagon train of about 4,000 wagons, marched on to Malvern Hill, with the loss of only about fifty wagons destroyed by the bombardment at White Oak Bridge, and were followed by the troops during the night, and the army was in position for the battle of MALVERN HILL (*q. v.*) the next day. See *Battles and Leaders of the Civil War*; Webb, *The Peninsula*; and the *Official Record.* JAMES MERCUR.

Frechette, frä'shet', LOUIS HONORÉ, LL. D.: Canadian author; b. at Levis, Province of Quebec, Nov. 16, 1839, and educated at Nicolet College. He was admitted to the bar in 1864, and had a seat in the Dominion Parliament from 1874 till 1879. He edited *Le Journal de Quebec* (1861–62); *Le Journal de Levis* (1864–65); *L'Amérique* (Chicago, 1868–70); and *La Patrie* (Montreal, 1884–85). He is now (1899) clerk of the legislative council of the Province of Quebec; is a knight of the Legion of Honor, officer of the Academy of France, late president of the Royal Society of Canada, and is regarded as the national poet of the French-Canadians. Two volumes of his poems, *Les fleurs boréales* and *Les Oiseaux de neige*, were crowned by the French Academy in 1880. Among other works in verse are *La Voix d'un Exile* (1869); *Pêle-Mêle* (1877); *La Légende d'un Peuple* (1887); *Les Feuilles Volantes* (1892). His prose works are *Lettres à Basile* (1871); *Histoire Critique des Rois de France* (1883); *Lettres sur l'Éducation* (1893); *Vieux Cartons* (3 vols., 1893). NEIL MACDONALD.

Freckles [connected with the verb *freak*, to variegate, to streak, O. Eng. *freken*]: discolorations of the skin taking the form of dark round spots, and found usually on the face or parts of the body exposed to the sun. With the exception of certain individuals known as "albinos," persons of every race and climate have colored skins, which differ only as to tint and degree of pigmentation. The color of the skin is due to a deposit of fine pigment granules in its outer layer which is known as the epidermis or cuticle. When this layer is removed—e. g. by a blister—the underlying skin is found to be white, whether the individual is a Negro or a Caucasian. Various portions of the skin are normally of deeper hue than surrounding parts, and exposure to the summer sun tends to increase the amount of pigmentation in most individuals. When the darkening of the skin is diffused and temporary in character it is called *tan.* When the discoloration appears in the form of small round spots and tends to be more permanent, we then have *freckles.* These spots usually appear on the face and backs of the hands, and fade or completely disappear in the winter. A few are sometimes found upon portions of the body not exposed to the sun, and persist indefinitely. Freckles are most apt to affect those of fair complexion and reddish hair, but even dark-skinned individuals, and especially mulattoes, are by no means exempt. The spots may be readily removed by any agent which will destroy the epidermis or superficial layer of the skin in which the pigment is deposited.
GEORGE HENRY FOX.

Fredegar (or **Fredega'rius**), SCHOLAS'TICUS: the name of a chronicler of the Franks, who, in conjunction with two or more other writers, wrote the *Historia Francorum*, which is a most important source for the early history of France. Its Latinity is very corrupt. Best edition by B. Krusch, *Fredegarii et aliorum chronica* (Hanover, 1888). M. W.

Frederic, HAROLD: See the Appendix.

Fredericia, fred-*e*-rish'i-a: town and fortress of Denmark; in Jutland, at the entrance of the Little Belt. On July 6, 1849, it was the scene of a victory of the Danes over the troops of Schleswig-Holstein. Pop. (1890) 10,044.

Frederick: city; capital of Frederick co., Md. (for location of county, see map of Maryland, ref. 2–D); situated on the B. and O. and the Pa. Railways, 60 miles W. by N. of Baltimore. It has numerous churches, a nunnery, 2 colleges, 2 female seminaries, a fine city-hall, several foundries, 2 large canning-factories, planing-mills, tanneries, coach-factories, flour-mills, spoke-factory, a large hosiery knitting-mill, a shoe-factory, etc. Frederick lies within 3 miles of the Monocacy battle-field, and 12 miles from the battle-field of South Mountain. The Confederate army, under Gen. Robert E. Lee, occupied Frederick for six days from Sept. 6, 1862, and on the 12th of the same month the Union army, under Gen. McClellan, entered and occupied the city. On July 9, 1864, it was again occupied by the Confederate army, under Gen. Jubal Early, who demanded and received as a ransom from her citizens $200,000. The remains of Francis S. Key, a native of Frederick County, and the author of *The Star-spangled Banner*, are buried in Mt. Olivet Cemetery adjoining the city, and the body of Roger B. Taney, chief justice of the Supreme Court of the U. S. (1836–64), is interred in the old graveyard belonging to the Roman Catholic church of Frederick. Barbara Frietchie, the good old dame who has been immortalized by Whittier, is buried in the old cemetery of the Reformed church. Pop. (1880) 8,659; (1890) 8,193; (1900) 9,296.
EDITOR OF "NEWS."

Frederick I., Emperor of Germany; also known as *Frederick Barbarossa.* After Henry IV., Emperor of the Holy Roman Empire, had been thoroughly humiliated by Pope Gregory VII. in the celebrated snow-covered courtyard of Canossa, he determined upon surrounding himself with a new and reliable set of followers. In pursuance of this policy he created Count Frederick von Büren Duke of Suabia, and at the same time bestowed upon him the hand of his daughter Agnes. Von Büren shortly after removed his castle to the summit of a mountain named Hohen Stauffen, and was thenceforth always called by that name, though his family was also known by the name of Weiblingen, from the castle Weibling—a name which was changed subsequently by the Italians into Ghibelline. When Henry IV. died, Frederick served Henry V. with the same fidelity. Upon the death of the latter emperor Frederick was an applicant for the crown, but his haughty manner set the electors against him, and Lothair of Saxony was elected. Upon Lothair's death, which followed soon after his election, Conrad von Hohenstauffen, Duke of Franconia and brother of Frederick, was elected King of Germany, but he was never crowned emperor by the pope. In 1147, when Bernard of Clairvaux started the second great crusade, Conrad was, after a long resistance, induced to join it, and took with him his nephew Frederick (b. 1121), son of Frederick of Suabia, whose merits made themselves so apparent to Conrad that after his return from the crusade, and when he felt his end approaching, he recommended his nephew to the German electors as his successor. Frederick Barbarossa (so named on account of his red beard) was thirty-one years old when the German princes elected him their king. He at once restored the Guelphic duke, Henry the Lion, to his dukedom of Bavaria, of which Conrad had dispossessed him, and having brought order into all the political affairs of Germany, went to his Lombardian possessions, where the larger cities had raised various disturbances. Frederick speedily restored order, and, having proceeded to Rome, was there crowned Emperor of the Holy Roman Empire in 1155 by Pope Adrian IV. He was in the zenith of his glory when he returned to Germany from his first expedition. Literature, art, and sciences now began to flourish in Germany, under Frederick's fostering care, as they had never flourished before. The cities of Lombardy, however, did not leave him long rest, and even the destruction of Milan by Frederick on his second expedition did not succeed in suppressing the spirit of revolt. Supported by the pope, Alexander III., three more insurrections took place; and when Frederick for the fifth time entered Italy to subdue his refractory subjects, he was terribly beaten at the battle of Legnano (1176). He then made peace with the pope, whose influence was supreme with the people of Lombardy, and hastened back to Germany to punish Henry the Lion, who had, forgetful of all Frederick's past generosity, refused to go with him on that fifth expedition, and had thus virtually brought about its disastrous end. This was the beginning of the endless conflicts between the Ghibellines (Frederick's party) and the Guelphs (the party of Duke Henry). Henry was dispossessed of all his lands, and retired to the court of his father-in-law, Henry II. of England. His two dukedoms, Bavaria and Saxony, were divided into smaller parcels among the emperor's friends, and thus Frederick put an end to the overbearing rule of the great German dukes and made the imperial rule supreme in Germany. He now went once more to Italy, but this time in peace, and was everywhere received in triumph. Upon his return Frederick organized the great crusade, in which Richard Cœur de Lion also took such prominent part. The unhappy conclusion of that crusade he was fortunately spared witnessing. While advancing in triumph at the head of his troops, after having stormed and taken the capital of the Sultan of

Credi, he was drowned in attempting to cross the Calycadnus June 10, 1190, or, as some say, died of a fever.

Revised by C. K. Adams.

Frederick II.: Emperor of Germany; b. at Jesi, in the March of Ancona, Dec. 26, 1194. He was the son of Henry VI., and, though elected King of the Romans in 1196 and King of Naples and Sicily in 1209, and though Duke of Suabia by inheritance, he did not succeed to the imperial crown until 1215, when, by the aid of the Ghibellines and Innocent III., his guardian, he successfully asserted his claim against Otho IV., promising the pope to go at once upon a crusade; but his long delay caused him much trouble with the popes, and the failure of his first two expeditions caused him to be twice excommunicated; and though at last he spent fifteen years in the Holy Land in successful warfare, taking Jerusalem (1229) and crowning himself king, he was never forgiven, and after his return was twice more excommunicated, and was involved in lifelong wars incited by the popes. D. at Fiorenzuola, Dec. 13, 1250.

Frederick III. of Germany: This title is sometimes given to the Duke of Austria, elected emperor in 1314, who reigned as joint emperor with Louis IV. from 1325 to his death, Jan. 11, 1330. By others he is reckoned as a King of Germany, but not an emperor. The Frederick III. of history was a son of Ernst, Duke of Styria and Carinthia, b. at Innspruck Dec. 21, 1415; in 1440 was elected emperor. He reigned fifty-three years, the longest German reign, but this period was one of almost continual civil wars. The emperor was a man of virtue, fond of learning and quiet, and in spite of the confusions of his reign managed to strengthen greatly his own family, which for almost 400 years retained the imperial dignity, and which still bears sway in Austria. D. at Linz, Aug. 19, 1493.

Frederick I.: the first King of Prussia; b. in Königsberg, July 11, 1657; succeeded his father, Frederick William the Great, as Elector of Prussia, with the title of Frederick III., in 1688. Deformed and feeble from infancy, his training was slighted, but on coming to power he declared null the will of his father, by which his half-brothers received a part of his inheritance, and thereafter by skillful diplomacy greatly strengthened his influence in foreign parts, at the same time enriching his treasury with foreign gold, obtained by the lending of troops, and from time to time enlarging his boundaries at the expense of small neighboring states. In 1701, with the consent of the emperor, he took the title of king. He maintained a splendid court, and was personally popular, though his excessive taxation was a grievous burden to the people. D. at Berlin, Feb. 25, 1713.

Frederick II.: third King of Prussia, commonly known as Frederick the Great; son of Frederick William I.; was b. Jan. 24, 1712. His early education was one of extreme rigor in consequence of the eccentric severity of his father, who determined to make him a hardy soldier and give him an education of an extremely practical nature. He was forbidden the study of Latin, but his tutors gave him great facilities for acquiring a knowledge of French and for the thorough study of history, especially the history of Germany. Notwithstanding the father's injunctions, his teachers connived at his disobedience, and he acquired a rudimentary knowledge of the Roman tongue. Frederick William was extremely passionate in his nature, and resorted to violent corporal punishment on very trifling provocation. In consequence of the restless and disobedient disposition of his son, the king gradually acquired for him a strange and almost passionate dislike. So harsh was the father's treatment that the son often thought of running away. At last, on a journey with his father in the south of Germany, in 1730, he determined to carry such a project into execution. His confidential advisers were two lieutenants in the army by the name of Katte and Keith. But the scheme was detected and both Katte and the prince were arrested. Keith made good his escape. Katte was condemned to imprisonment for two months, but the king insisted upon his execution, and he paid the penalty of his friendship and fidelity with his life. Under Prussian law the punishment of a military officer for desertion was death, and as Frederick held the rank of lieutenant-colonel his life would doubtless have been subject to forfeit if he had carried out his plan of actual desertion. The king chose to act as he would have done in case the desertion had been accomplished. Frederick was condemned to death, and it was only after numerous petitions had been received from the crowned heads of Europe that a reluctant pardon was finally granted. During the next ten years Frederick showed no spirit of disobedience. At the king's suggestion he even married with apparent cheerfulness Elizabeth Christina of Brunswick-Bovern, a princess for whom he had no fondness whatever. His studies in French resulted in a correspondence with Voltaire, and the establishment of a friendship that was in many ways to influence his subsequent life. During this period he developed marked abilities as a student and writer; and two of his works published before he ascended the throne are still entitled to consideration. In the *Anti-Machiavel* and the *Considérations sur l'État présent du corps politique de l'Europe* he called attention to the growing importance of France and Austria, and the necessity of some third power that should be strong enough to neutralize their influence.

On the death of his father Frederick ascended the throne in 1740. It was evident from the first that his methods would be far more tolerant than those of his predecessor. He proclaimed freedom of religion, greatly advanced the freedom of the press, established the impartial administration of justice, and granted the absolute right of petition to all those who had any grievance. But it was in foreign matters that his discrimination and force of character made themselves most conspicuously seen. On the year of his ascension the Emperor Charles VI. died, leaving his inheritance to his daughter Maria Theresa. Frederick at once began the most active preparations for war. Though he had subscribed to the Pragmatic Sanction by which Maria Theresa was confirmed in her inheritance of her father's rights, Frederick held that such confirmation did not extend to any territory not rightfully held by her father. The right of Austria to Silesia Frederick disputed on the ground of an old compact the conditions of which had not been fulfilled by Austria. For setting up a claim to Silesia Frederick has been subjected to a vast amount of unwarranted criticism; for it is difficult to investigate the grounds of the claim without recognizing the fact that the terms on which Silesia had been given to Austria had not been carried out. Whether Frederick can be justified in resorting to war to establish his claim is another question; but at least it must be judged in the light of the customs of the eighteenth century.

After some preliminary negotiations at Vienna, Frederick invaded Silesia with an army of 30,000 men. His forces gained the first victory at Mollwitz Apr. 10, 1741; the second at Chotusitz May 17, 1742. As Maria Theresa was at war with France she consented to the Peace of Breslau June 11, 1742, which ceded to Prussia Upper and Lower Silesia as far as the river Oppa. But Frederick was convinced that Austria would not allow this treaty to be permanent. He therefore not only strengthened his army, but he also made alliances with France and Bavaria, and pledged himself to respect the imperial rights of Charles VII. Convinced that a war was impending and was inevitable, he invaded Bohemia and took possession of Prague in 1744. In 1745 he fought and gained the brilliant battles of Hohenfriedberg, Sohr, Hennersdorf, and Kesselsdorf. The Peace of Dresden, Dec. 25, 1745, confirmed his possession of Silesia.

The next eleven years were years of peace for Frederick, and he used them industriously and successfully for the development of his realm. He restored the Academy of Sciences; made canals between the Oder and Elbe; and developed the country by improving the methods of justice and administration. Though he habitually wrote and spoke French, and affected to despise German as the language of boors, he predicted for his mother-tongue a great future. Voltaire and Maupertuis became the center of literary activity at Berlin.

Maria Theresa had never abandoned hope of recovering Silesia. Prussia was now becoming so strong that the queen had no difficulty in arraying a very powerful combination against Frederick. One after another, Russia, Saxony, and France formed an alliance with Austria. In Jan., 1756, a convention was signed between Prussia and England which proved to be of incalculable advantage to both countries. Through the treachery of a Saxon clerk Frederick learned what was awaiting him. In Aug., 1756, realizing the advantage of striking the first decisive blow, he crossed the frontier of Saxony, and after a short but brilliant campaign defeated the Austrians at Lowositz, and compelled the Saxon army to surrender. This campaign proved to be the beginning of the memorable Seven Years' war, in which Prussia, supported though not very actively assisted by England, was assailed by Austria, Russia, France, Saxony, and Sweden.

Practically all Europe was turned against the little kingdom, which had hitherto been regarded as of scarcely more than insignificant importance. But the Prussians were led by a great commander who infused his own spirit into his armies, and seldom in history has military genius accomplished greater results. At the moment when Frederick seemed on the point of being ruined he succeeded in separating his enemies and overwhelming them, one after another. In Nov., 1757, he crushed the French in a remarkable battle at Rossbach, and a month later at Leuthen he defeated the Austrians and drove them out of Silesia. In 1758 he overthrew the Russians at Zorndorf, and in 1760 gained important victories at Liegnitz and Torgau. But notwithstanding these successes there were periods in the war of great danger. On Aug. 12, 1759, he was disastrously defeated in the battle of Kunersdorf, and nothing but a combination of fortunate circumstances prevented the loss of his cause. For a short time even Frederick believed that all was lost, and gave orders accordingly. But his enemies were slow in pressing their advantage. Most fortunate of all, on the death of the Czarina Elizabeth, Russia not only withdrew from the cause of Austria, but even became an ally of Prussia. All Europe was tired of the war, and the Peace of Hubertsberg, signed in 1763, confirmed Prussia in her claims.

It would be difficult to exaggerate the effect upon Europe of the Seven Years' war. It not only made Prussia one of the foremost powers of the Continent, but put the nation by the side of Austria in the contest for German supremacy. Not less important, it occupied France at a time when that nation was contending with Great Britain for the mastery in America and in India. With France fully occupied in Europe, Great Britain had a much easier task in gaining supremacy in other quarters of the world. But all this was purchased at a fearful price. The resources of Prussia at the close of the war were very nearly exhausted. The genius of Frederick, however, was no less marked in peace than it had been in war. Gradually the signs of disaster were effaced by his statesmanship, and long before the death of the great king Prussia had become for the first time what may be called a modern nation. In the course of his career Frederick had shown a constant inclination to literary activity. His collected writings, published by the Academy (1846–57), are comprised in thirty magnificent volumes. His death occurred Aug. 17, 1786.

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C. K. ADAMS.

Frederick III.: the second German emperor and eighth King of Prussia; b. near Potsdam, Prussia, Oct. 18, 1831; son of the German emperor William I.; was carefully educated under the direction of Prof. Ernst Curtius and the Rev. W. Godet; studied at the University at Bonn in 1849–50; traveled extensively in different parts of Europe; learned the art of war under Moltke; married in 1858 the eldest daughter of Queen Victoria; entered the military service in early life; bore an important part in the Austro-Prussian war of 1866, in which he commanded the Second Army, numbering some 125,000. During the Franco-German war he led the Third Army, which consisted of about 200,000 men and 500 guns; won the victories of Weissenburg and Wörth, and bore a distinguished part in the succeeding events of that war. (See FRANCO-GERMAN WAR.) He was general field-marshal and general inspector in the German army. On the death of his father, Mar. 9, 1888, he became German emperor and King of Prussia. Even before his accession a malignant affection of the throat had rendered tracheotomy necessary, and it was evident that his life was in danger. In the course of the three months of his reign he bore his suffering with the greatest fortitude, and did much to liberalize the institutions of his people. D. June 15, 1888.

Frederick Charles Nicholas, FIELD-MARSHAL PRINCE: b. in Berlin, Mar. 20, 1828; a nephew of the Emperor William of Germany; was educated at Bonn: entered the army in youth; served with distinction in Schleswig (1864); had an important share in the victory of Sadowa (1866), where he displayed great energy and skill; commanded the Second German Army (consisting of six army-corps, with some 260,000 men and 500 guns) in the Franco-German war; had command in the siege-operations against Metz; after the surrender was made a field-marshal, and afterward dispersed the army of the Loire in six weeks. D. June 15, 1885.

Frederick William, THE GREAT ELECTOR: eleventh Elector of Brandenburg; b. Feb. 6, 1620; succeeded his father, George William, in 1640, and found his dominions in a deplorable state of ruin, caused by the ravages of the Thirty Years' war and by the misrule of his predecessors; made an advantageous peace with Sweden (1648); reorganized the army; joined Sweden against the Poles in 1655, and freed Brandenburg from the Polish sovereignty, and was himself recognized as sovereign of Prussia (1663); took a leading part (1672–73) in the war with Louis XIV.; routed the French at Fehrbellin (June 18, 1675), and by 1679 had expelled them from Prussia and Pomerania. In 1685 he greatly enriched his provinces by offering an asylum to the French Protestants. The last years of his reign were devoted to the development of the material prosperity of his territories. Though not himself proclaimed king, he prepared the way for his successor, Frederick I., who was raised to that rank in 1701. D. at Potsdam, Apr. 29, 1688.

Frederick William I.: King of Prussia; b. in Berlin, Aug. 15, 1688; succeeded his father, Frederick I., in 1713. He maintained a standing army and collected a full treasury; forced the surrender of a large part of Swedish Pomerania to his sway; abolished feudal tenures (1717); was often cruel and unjust, as in the treatment of his son, the future Frederick the Great; had a whimsical passion for forming a guard of giant soldiers, for whom he found giant wives. His character was unamiable and full of apparent contradictions, and the ruling purpose of his life was the assurance of the future greatness of Prussia, through the economical rule of his own family. D. at Potsdam, May 31, 1740.

Frederick William II.: King of Prussia; b. Sept. 25, 1744; succeeded his uncle, Frederick the Great, in 1786, and by a natural reaction from the enforced severity of his previous life entered upon a course of immoderate luxury. He lost the trans-Rhenish provinces to the French republic in 1795, but his share in the second and third partitions of Poland (1793–95) largely extended his sway. His extravagance and tyranny were partially offset by legal reforms and the encouragement of Prussian industries. D. Nov. 16, 1797.

Frederick William III. of Prussia: b. Aug. 3, 1770; succeeded his father, Frederick William II., in 1797; undertook at once the reform of the abuses of his father's reign, and by treaties increased his dominions. During the early part of his reign he preserved neutrality with Napoleon, but the policy of the French emperor so exasperated the Prussians that they forced the king to declare war against the French in 1806. The battles of Jena, Auerstadt, Eylau, and Friedland, followed by the Peace of Tilsit (1807), were most disastrous to Prussia, and reduced it to half its former extent; but through political reforms, the abolition of serfdom, the sale of royal domains and church property, and the reorganization of the army, the king, inspired by Queen Louise and directed by the great Minister Stein, went far toward making the calamity of Prussia a great blessing. In 1813 the War of Liberation from the French was inaugurated; the battles of Lützen, Bautzen, Leipzig, and Brienne, and the occupation of Paris by the allies, followed, and Prussia became more powerful than ever before, chiefly at the expense of Saxony. At Waterloo the Prussian army also performed a most important part. In the closing years of his reign a conservative policy was adopted. D. June 7, 1840.

Frederick William IV. of Prussia: b. Oct. 15, 1795; was carefully educated; served in the wars against Napoleon, and was exceedingly popular in early life. In 1840 he succeeded his father, Frederick William III., and by his reactionary policy disappointed the high hopes which had been indulged regarding him. The affairs of the Zollverein (established 1819) were so managed as to increase Prussian influence, and internal improvements were pushed forward, but in 1841 the king refused the request of the estates for a constitution, and repeatedly declared that the estates should be convened only at his own will, and then only as an advisory body, with no legislative power. The revolution of 1848 followed, but the victories of the army gave the king confidence, and in place of the constitutions proposed by the revolutionists he promulgated one of his own and dissolved the popular assembly. In 1849 he declined the imperial crown tendered him by the Frankfort Diet. In 1857 he was seized with temporary fits of insanity, and yielded the crown to his brother, William I., who acted as regent until Jan. 2, 1861, when, on the death of his father, he succeeded to the throne.

Frederick III., The Pious: Elector of the Palatinate 1559–76; was educated at the court of Charles V., but married a Lutheran princess in 1537, and openly embraced Lutheranism in 1549. In the Palatinate the Reformation had been introduced in its Lutheran form, but just as Frederick III. ascended the throne the violent controversy concerning the Lord's Supper broke out between the Lutheran and the Reformed theologians. The teachings of Melanchthon seemed to lead in the direction of Zwingli and Calvin, the disputation at Heidelberg gave the victory to the Reformed theologians, and, as the population seemed to lean toward Calvinism, the festivals of Mary and the saints were abolished, the altars, organs, images, baptismal fonts, etc., were removed, the Church government was vested in a council board consisting of three ecclesiastical and three lay members, Reformed teachers and preachers were appointed instead of Lutherans; in short, the Lutheran Church was supplanted by the Reformed. The Lutheran princes of the empire even threatened the elector with deposition, but he proved steadfast; and the Palatinate became the principal home and chief support of Calvinism in Germany.

Frederick Henry Island: an island claimed by the Dutch; situated in lat. 8° S., lon. 138° 30′ E.; area about 400 sq. miles. It is separated from the mainland of New Guinea, of which it forms the southwest part, by the narrow Strait of Dourga, or Marianne. Arafura Sea separates it from Australia on the S.

Fredericksburg: town; capital of Gillespie co., Tex. (for location of county, see map of Texas, ref. 5–G); 80 miles W. of Austin. It has five churches, a good graded school, an ice-factory, cotton-gins, flouring-mills, and a lively trade in wheat, corn, and merchandise. The situation is elevated and healthful. Fredericksburg was settled in 1846 by a German colony. Pop. (1880) 1,085; (1890) 1,532; not returned separately in 1900.

Fredericksburg; city and railway junction; Spottsylvania co., Va. (for location of county, see map of Virginia, ref. 5–H); on the south bank of the Rappahannock river, 92 miles from its mouth, at the head of tide-water; 60 miles S. of Washington, and 61 miles N. of Richmond. The river is navigable for steamers and sailing vessels. The city has very great water-power supplied by a dam constructed across the Rappahannock just above the city, 900 feet long, and 18 feet high, giving a fall of 48 ft. 2 in., and affording some 6,000 horse-power. Fredericksburg has numerous churches, 7 schools, a public library, 3 large flouring-mills, a tannery, 2 sumac-mills, 2 large iron-foundries, a shoe-factory, an extensive woolen-mill, a silk-mill, an ice-factory, 2 cigar-factories, a carriage-factory, a planing-mill, a large sawmill, water-works, gas-works, electric lights, and two fine iron bridges across the Rappahannock. During the civil war it was the scene of several bloody contests. Pop. (1880) 5,010; (1890) 4,528; (1900) 5,068.

Editor of "Lance."

Fredericksburg, Battle of: Dec. 13, 1862, the first great battle of the U. S. civil war after Antietam; was fought by the Union forces under Gen. Burnside and the Confederates under Gen. Lee. Early in Nov., 1862, half of Lee's army under Longstreet was at Culpeper, Va., and the remainder under Jackson in the Shenandoah valley. On Nov. 7 McClellan, who was in command of the Army of the Potomac, was superseded by Burnside, who organized the army into three "grand divisions" of two corps each, under Gens. Sumner, Hooker, and Franklin, and concentrated it at Falmouth, opposite Fredericksburg, Va. Lee, to meet Burnside's movement, sent Longstreet to Fredericksburg, where he arrived Nov. 19, Jackson coming up a day or two later. The Confederates took up a position on the heights back of the city. Between these heights and the river lay open cultivated fields sloping gently to the river-banks, which were bluff. During the three weeks that the Confederates occupied this position before they were attacked, they availed themselves of the opportunity to become familiar with the ground and to fortify points which seemed weak. The Union army occupied Stafford Heights on the east (left) bank of the river, which were higher than the hills occupied by the Confederates on the west (right) bank, but were distant from them from 1¼ to 2 miles. The Union reserve artillery was massed upon these heights to sweep the plateau on the other side of the river. On the morning of Dec. 11 the construction of the bridges for crossing was begun. Two points were selected: one opposite the upper end of the city, the other a mile and a half farther down the stream. Franklin began crossing at the latter point at about 4 P. M., but withdrew most of his forces to await the completion of the other bridges. At the upper bridges the Confederate sharpshooters in the brick houses along the bank at first prevented all attempts to build the bridges, in spite of a most vigorous cannonading; but at about 4.30 P. M. were finally driven out by troops ferried over in pontoons, and the bridges were then built. The army commenced crossing that evening and occupied the town. The rest of Sumner's division and part of Hooker's crossed on the 12th. The remainder of Franklin's division also crossed after Sumner's bridges were finished. During the night of the 12th and under cover of a fog on the morning of the 13th the army was formed for attack. Between 9 and 10 A. M. the fog lifted and the battle began with the attack of Franklin's division upon the Confederate right at Hamilton's Crossing, held by Jackson with 30,000 men. This attack penetrated the Confederate front line and drove it back upon its reserves, until such strength was developed that the Union line was finally checked and driven back nearly to its original position. Desultory fighting continued upon this flank during the day with no material advantage to either side. On the Union right wing Sumner's and part of Hooker's troops, which had been concealed in the streets of Fredericksburg, moved out at about noon, formed and advanced to the attack of Marye's Heights. In making this attack they were exposed to a concentrated cross-fire of artillery and, upon a near approach to the Confederate position, to a most deadly infantry fire from the troops in a sunken road, which constituted the Confederate line of defense, and from those upon the hill above them. The attacking lines were cut down and destroyed by this fire, but fresh troops were again and again sent against the position until nightfall. During the night Burnside, becoming convinced through the representations of his subordinates, that the position could not be carried, gave up the idea of renewing the attack. The armies lay facing each other until the night of Dec. 15, when Burnside recrossed the river without molestation. The total Union force was about 116,000 men; the losses, 1,284 killed, 9,600 wounded, and 1,769 missing; total, 12,653. The total Confederate force was about 78,000; the losses, 608 killed, 4,116 wounded, and 653 missing; total, 5,377. See *Official Record*, articles in *Battles and Leaders of the Civil War*, and Scribner's War Series.

James Mercur.

Fred′ericton: a beautiful city and a railway center (incorporated in 1849); capital of New Brunswick and of York County (for location, see map of Quebec, etc., ref. 5–G); situated on the right bank of the river St. John, 84 miles from its mouth, in a fertile and well-cultivated plain bounded on the one side by the river and encircled on the other by a range of low wooded hills. It is finely laid out and has many handsome buildings. Among the public buildings of importance are the government-house, the province building, Victoria Hospital (erected 1887), court-house, city-hall, barracks, the exhibition building, the custom-house, jail, etc. Fredericton is the seat of an Anglican bishopric, of the University of New Brunswick, and of the Provincial Normal School, and has eight churches, Christ Church Cathedral (Anglican), a Baptist seminary, and several libraries. The city is engaged chiefly in commerce and the trade in lumber. The river is navigable to this point by large steamers; above small steamers ply during high water, proceeding as far as Grand Falls. A steam-ferry connects it with St. Mary's, on the opposite bank of the river. Fredericton was founded by Villebon in 1692 as a fort; was unsuccessfully attacked in 1696 by New Englanders; under the name of St. Ann's Point was temporarily made the capital of New Brunswick in 1701; and the government was permanently established there by Sir Guy Carleton in 1786. Pop. (1881) 6,218; (1891) 6,502; (1893) about 8,000.

Fred′erik: the name of seven kings of Denmark belonging to the Oldenburg dynasty. Under the reign of Frederik III. (1648–70) the constitution of the country was changed from an elective monarchy, in which the power of the crown was circumscribed within very narrow limits by the privileges of the nobility, to an hereditary monarchy, in which the crown was invested with an absolute and unlimited power (Nov. 14, 1660). Under Frederik VII. (1848–63) this constitution was again changed, and the present constitution established (June 5, 1849), according to which the executive power rests with the king and his responsible ministry; the legislative power, with the *Thing*, consisting of an upper and a lower house, elected indirectly and directly by the people; and the judicial power, with courts, in which the judges are appointed by the king, but for life. At the death of Frederik VII. (Nov. 15, 1863) the Oldenburg dynasty became extinct, and was succeeded in Denmark by the house of Sonderburg-Glücksburg.

Frederikshald, fred'er-iks-haald: town of Norway; in the stift of Aggershuus; 50 miles S. S. E. of Christiania (see map of Norway and Sweden, ref. 11–D). To the S. E. is a strong castle, Frederiksten, standing on a perpendicular rock 350 feet high, overhanging the sea, and considered impregnable. Here, Dec. 11, 1718, at the siege of this fortress, Charles XII. of Sweden was killed. The town has a fine harbor and considerable trade in iron and lumber. Pop. (1891) 11,183.

Frederikstad, -staad: a seaport of Norway; at the mouth of the Glommen; 50 miles S. E. of Christiania (see map of Norway and Sweden, ref. 11–D). It has a spacious harbor, a good trade, thriving manufactures of hardware, pottery, agricultural implements, brandy, etc., and carries on a considerable shipping trade, besides its lumber business. A mile and a half from the town is the fall of the Glommen, called Sarpen. The town was formerly strongly fortified, and in 1716 Charles XII. of Sweden in vain attempted to capture it. Pop. (1891) 12,307.

Fredo'nia: city; capital of Wilson co., Kan. (for location, see map of Kansas, ref. 7–I); on Fall river, and on the A., T. and S. F., the Missouri Pacific and the St. L. and S. F. Railways; 85 miles E. by S. of Wichita; in a fine farming region. Pop. (1880) 923; (1890) 1,515; (1900) 1,650.

Fredonia: village; Chautauqua co., N. Y. (for location of county, see map of New York, ref. 6–B); situated on the D., A. V. and P. Railroad; 40 miles S. W. of Buffalo and 3 miles from Lake Erie. It is the seat of a State normal school, built by the village at a cost of $100,000. The raising of garden-seeds, grapes, grape-vine roots and other nursery-stock is extensively carried on. The village has large carriage-factories, felt-pad works, etc., sewers, water-works owned by the village, electric lights, and an electric street railway connecting it with Dunkirk. Since 1824 it has been provided with natural gas, obtained by boring into the bituminous shale. Here was organized the first grange of the Patrons of Husbandry. The first academy in Western New York was established here in 1824; its library of some 2,000 volumes has been transferred to the normal school building. Pop. (1880) 2,692; (1890) 3,399; (1900) 4,127.

Free Bench: in English law, an estate in many respects resembling dower, which by the custom of most manors the widow has in the copyhold estates of which her husband was a tenant. In some manors the husband's estate in the copyholds of which his wife was a tenant is also called free bench, but this interest is usually termed his courtesy, and free bench applied only to the widow's interest.

This is a customary right, and as such is not governed by any general law, as in the case of dower, but is dependent upon the local custom for the quantity, character, and duration of the estate which the widow takes.

Unlike a dower right it may be defeated by any alienation of the husband, either by deed or by will, but is paramount to his debts. The former remedy for enforcing the right of free bench was by a plaint in the manor court, but the remedy is now by writ of summons and notice after a form of procedure prescribed by the Common Law Procedure Act of 1860.

F. STURGES ALLEN.

Free Church of Scotland: That branch of the Presbyterian Church in Scotland which separated from the Established Church in 1843. The movement in the Church of Scotland which terminated in the formation of this is closely connected with controversies which have lasted for more than 300 years. (For the earlier history of these controversies, see the article SCOTLAND, CHURCH OF.) In 1647 an act of the Assembly of the Scottish Kirk was passed, adopting the Westminster Confession with two modifications—the one in favor of the system of presbytery, which is omitted from the Confession, and the other affirming the right of the Church to meet in synods and assemblies without the consent of the magistrate.* On Mar. 9, 1649, the Scottish Parliament passed an act abolishing patronage in the Kirk, as being unlawful and unwarrantable by the word of God and contrary to the doctrines and liberties of the Church. The General Assembly in June of the same year passed an act entitled "The Directory for the Election of Ministers," in which it was declared that the kirk session, or board of elders elected by the congregation, should elect the minister, and intimate their election to the congregation for their approbation; if the majority dissented, another election was to take place. No minister was to be settled but "upon the suit and calling of the congregation." The session elected but the congregation must mark their consent by an orderly call before the settlement could take place. This Assembly completed what is usually spoken of as the Second Reformation of the Kirk, in which the great principles of her Presbyterian constitution and her inherent right of spiritual jurisdiction were vindicated.†

After the restoration of Charles II. patronage was restored in connection with the introduction of the episcopal form of church government.

We pass on to the union of the two kingdoms of England and Scotland and the merging of the two legislatures in one Parliament. This was preceded by a succession of legislative acts which were intended to secure to the Scottish nation, by the most solemn guarantees, the maintenance of the doctrines, principles, and government of the Kirk. In 1705 the act for securing the Protestant religion and Presbyterian church government was passed by the Scottish Parliament, and was afterward incorporated into both the Scottish and English acts for ratifying and approving the union. This act received the royal sanction in 1707, when the union was consummated, and has been regarded by Scotchmen not as a simple legislative statute, but as a fundamental and essential condition of the treaty of union.‡ This important act not only confirms the act of 1690, ratifying the Confession of Faith and settling the Presbyterian church government, but also the other acts which followed that, abolishing the royal supremacy, and substituting the election of the session and the call of the congregation for the presentation by lay patrons. But in 1711 the famous act of Queen Anne for the restoration of patronage was passed, and on this act the present practice of patronage in the Church of Scotland rests. All parties in the Kirk united in resisting the restoration of patronage; the General Assembly, while yielding to it, continued for many years to protest against it. Lord Macaulay thus speaks of the serious consequences of this alleged breach of the constitution of the Church of Scotland: "The British legislature violated the articles of union and made a change in the constitution of the Church of Scotland. From that change has flowed almost all the dissent now existing in Scotland. Year after year the General Assembly protested against the violation, but in vain, and from the act of 1711 undoubtedly flowed every secession and schism that has taken place in the Church of Scotland."§

The question here arises as to whether the terms of the Revolution settlement, subsequently ratified by the treaty of union between England and Scotland, are legally so stringent that they could not be altered by subsequent legislation without a breach of the covenant. It must be noticed that it has proved to be impossible for one generation to bind all those who succeed it in any department of human interest, and least of all in the sphere of religion. The acts that were embodied in the treaty of union required all university professors to sign the Confession of Faith and submit to the government and discipline of the Kirk. This was, equally with the abolition of patronage, a fundamental condition of the union; but in 1853 a Universities (Scotland) Act was passed by the Parliament which limited this subscription to theological professors. In the present condition of parties in Scotland the right of the legislature to make this change will scarcely be questioned. The subject in its purely legal aspect is not without difficulties, but it can not be maintained that the legislature of to-day is bound to perpetuate what it regards as inexpedient or even wrong because it was a condition of the treaty of union 200 years ago.

It must, however, be borne in mind that the act of Queen Anne which abolished patronage was in direct opposition to the declared principles of the Church of Scotland and to various solemn acts both of the General Assembly and of

* Innes, 65.
† Baillie, Hetherington, and Innes.
‡ Act of Security, Innes, 117.
§ Macaulay, *Speeches*, ii., 180

Parliament. No change in the opinions of the Scottish Church or nation had taken place to warrant such a breach upon the constitution of the Kirk, and the measure was passed in spite of the earnest remonstrance and protest of the Church and nation. Apart, therefore, from the grave question in reference to the irrevocableness of any statute, the act itself was unwarranted, and its consequences were as serious as Lord Macaulay has represented them to be.

The history of the Church of Scotland from 1711 to 1834 is marked by many instances of the intrusion of ministers into parishes against the will of the people. In 1736 the Assembly passed an act against the intrusion of ministers into vacant parishes, and up to 1784 the Assembly continued from year to year to remonstrate against the law of patronage and instructed each succeeding commission * to make application to the king and Parliament for redress of the grievance. A case of disputed settlement under the patronage act led to the first Secession, in 1733, and another case of the same kind led to the formation of the Relief Church in 1752.

A full statement of the facts of these Secessions belongs properly to the history of the United Presbyterian Church in Scotland. From the time of the second Secession the dominant party in the Church continued to enforce the law of patronage for many years, but a minority within the Church continued to protest against the intrusion of ministers and to contend for the doctrine of spiritual independence. About the beginning of this century the party opposed to patronage, now known as the "Evangelical party," was greatly increased. The settlement of Dr. Andrew Thomson as minister of St. George's church, Edinburgh, in 1810, and the subsequent publication of the *Christian Instructor* under his management as editor, gave a great impulse to the Evangelicals.† In this work of rousing the energies of the Scottish people to seek ecclesiastical reform he was joined by Dr. Thomas McCrie, the historian, and shortly afterward, in 1815, Dr. Thomas Chalmers was removed from the country parish of Kilmany to the Tron church of Glasgow, and threw all his talents and energies into the same great work. These three ministers were of those men who stamp the impress of their own characters upon the age in which they live, and were influenced by the same strong lofty views of the independence of the Church, and by the same ardent love for the principles which they regarded as fundamental to the constitution of the Reformed Church of Scotland. In 1825 an anti-patronage society was formed, the most active member of which was Dr. Andrew Thomson, but the majority of the Evangelical party declined to unite with it, and continued to seek the regulation and control of the law without contemplating its total abolition. In 1832 overtures from three synods and eight presbyteries were laid on the table of the General Assembly, representing that the call had been reduced to a mere formality, and praying that measures be adopted to restore it to its constitutional and salutary efficiency. A motion declaring it to be inexpedient to take any action was carried by a majority of forty-two. At the Assembly in 1833 no less than forty-five overtures asking for the restoration of the call to its proper place in the constitution of the Church were presented. Dr. Chalmers moved that the dissent of a majority of the parishioners be conclusive against the settlement of a minister, provided the objections were not founded on malice or caprice. A motion, in effect continuing the practice then in use, was carried by a majority of twelve. The agitation of the subject was continued, and at the General Assembly of the following year (1834) a great number of overtures brought up the discussion of the call, and a motion made by Lord Moncrieff to the same purport as that made by Dr. Chalmers in the preceding year was carried by a majority of forty-six. The act on calls, generally known as the "veto act," was only a half measure. Instead of giving any direct efficacy to the call of the people, which was what the constitutional principles of the Church warranted, it simply rendered the dissent of the people conclusive against the presentee; but the passage of this act marks the beginning of the "ten years' conflict" between the ecclesiastical and the civil power in Scotland. The first case that arose under this new act will serve as an illustration of the conflict which was carried on between the co-ordinate courts.

* The commission of Assembly is a kind of committee of the whole, which has power to meet at any time of the year in reference to any matters which may affect the interests of the Church.

† The terms *Evangelicals* and *Moderates* are used to save circumlocution.

The church and parish of Auchterarder having become vacant in Aug., 1834, on Sept. 16 thereafter the Earl of Kinnoul, as patron, issued a presentation in favor of Robert Young, a licentiate of the Church. The call was laid before the presbytery on Oct. 14, and in terms of the veto act and its relative regulations the matter was brought before the parishioners. The call was signed by the Earl of Kinnoul's factor, not a resident in the parish, and by two heads of families. On the other hand, 287 heads of families, being communicants, subscribed a dissent from the call. In consequence of this the presbytery rejected Mr. Young as presentee to the parish. Mr. Young appealed first to the synod and afterward to the Assembly, but both of these courts reaffirmed the decision of the presbytery by large majorities. Thereupon the Earl of Kinnoul and Mr. Young instituted a process in the court of session,* contending that the rejection of Mr. Young as presentee was *ultra vires* of the presbytery, in violation of the statutes, and to the serious injury of their patrimonial rights as patrons and presentee. The presbytery of Auchterarder asked advice of the commission of Assembly which met Nov., 1835, and the commission instructed their procurator, or legal agent, to conduct the defense at the expense of the Church. On Mar. 8, 1838, the court gave its decision by a majority of three—the numbers being eight and five—to the effect that the presbytery had acted to the hurt and prejudice of the patron and presentee, illegally and in violation of their duty, and contrary to the provisions of the statute of Queen Anne for the restoration of the rights of patrons. At the next meeting of the presbytery of Auchterarder the whole matter was referred to the synod, and from thence sent up to the General Assembly, which met in May, 1838. The Assembly authorized the procurator of the Church to appeal the case to the House of Lords, and on May 3, 1839, the judgment of the House of Lords was given to the effect that the appeal be dismissed and the decision of the court of session affirmed. Thus the highest legal judicatory in the kingdom declared the veto act to be illegal, and that the law recognizes neither the call nor the objections of the people in the appointment and ordination of a minister to a parish, and that, if they interfere with the patron in the exercise of his right, they must be put down. A crisis had now arrived, and the General Assembly of 1839 met prepared to deliberate on the course to be taken. Dr. Cook, as leader of what was called the Moderate party, moved, in effect, that as the veto act had been pronounced illegal by the supreme civil tribunals of the country, the General Assembly should instruct all presbyteries to proceed in the settlement of parishes according to the practice which prevailed previously to the passing of that act. Dr. Chalmers, as leader of the Nonintrusion party, moved a resolution affirming the readiness of the Church to give obedience to the civil courts so far as the civil rights and emoluments of the Church were concerned, but at the same time declaring the principle of nonintrusion to be an integral part of the constitution of the Reformed Kirk of Scotland, and that the principle could not be abandoned; therefore no presentee should be forced upon any parish contrary to the will of the congregation. This resolution further provided for the appointment of a committee, with instructions to confer with the Government of the country with a view to the restoration of harmony between Church and state. This motion was carried in the Assembly by a majority of forty-nine. It declared in effect that the civil courts might do what they chose with the emoluments of the parish of Auchterarder, but that the Church courts could not proceed at the dictation of these courts to the ordination and settlement of Mr. Young. Thus terminated for a time the Auchterarder case, but the collision between the Kirk and the civil courts continued.

The position of the Church was becoming more and more difficult and complicated. The Nonintrusionists were willing to abandon the temporalities of the benefices, and claimed for the Church only spiritual and pastoral rights; but this was met, on the part of the civil courts, by the principle that ministers of the national Church were statutory functionaries, bound to perform their duties as fixed by the supreme courts, and that they could not evade these duties by merely abandoning the emoluments. Meanwhile some attempts were made to afford relief from this conflict of jurisdiction by means of legislation. In May, 1846, the

* The court of session is the supreme civil court in Scotland, having jurisdiction in all civil cases of whatever nature. It was instituted in 1532. The number of judges is thirteen—the lord president, the lord justice's clerk, and eleven ordinary lords.

Earl of Aberdeen brought forward a bill on the Church question, but it failed to meet the difficulties, inasmuch as it acknowledged the validity neither of the veto nor of the direct call, and left the proceedings of the Church courts subject to the review of the court of session. After a second reading it was withdrawn. The General Assembly of 1842 transmitted to the crown "the claim, declaration, and protest anent the encroachments of the court of session." "The Claim of Rights," as it was called, is a most valuable historical document, gathering up the principles of the majority in the Assembly, and giving a comprehensive statement of the scriptural, constitutional, and legal grounds on which these principles rested, of the wrongs which the Church had sustained from the civil courts, and of the claim for protection which she put forth. It closed with a solemn declaration that at all hazards the Church was prepared to defend and maintain her inalienable rights. Toward the close of the year 1842 a convocation was called to take into consideration the position of the Church in relation to the civil courts. This meeting was opened on Nov. 17, and about 450 ministers were present. A memorial to Government was subscribed by nearly all the ministers present, by which they committed themselves to the relinquishment of the Church temporalities if they could no longer hold them in consistency with the free and full exercise of their spiritual functions. Mr. Maule introduced a motion into the House of Commons, Mar. 7, 1843, to the effect that the house should resolve itself into a committee to take into consideration the grievances of which the Church of Scotland complained; 76 voted for this motion and 241 against it, but the Scottish members voted in the proportion of 2 to 1 in its favor. It was felt in Scotland as a grievance that in a purely Scottish question the voice of Scotland, as expressed by her representatives, was overborne by the votes of English and Irish members. With this decision the negotiations for relief from the conflict of opposing jurisdictions by means of legislation came to an end.

The Assembly met on May 18, 1843. That day witnessed a transaction which profoundly agitated the Scottish nation; a thrill of enthusiasm passed from heart to heart such as had not been felt for centuries. After the usual preliminary services, the Rev. Dr. Welsh, as moderator, impressively declared that it was impossible to constitute a free Assembly under the conditions of establishment as now fixed by the civil authorities, and then read the protest. The protest having been laid on the table, he rose and left the chair, and proceeded up the aisle to the door; he was speedily joined by Dr. Thomas Chalmers, and they were followed by over 400 ministers and a still larger number of elders. They were received by the people outside the church with prolonged cheers, and as the crowd fell back on either side to allow them to pass out, they spontaneously, though without any previous arrangement, fell into a line three abreast, and thus made their way to the large hall at Cannonmills which had been prepared for their reception. Dr. Chalmers was elected the first moderator of the Free Assembly, and the Secession was completed by the subscription of the act of separation and disruption. Four hundred and seventy ministers thus abandoned the Church of Scotland as by law established, renouncing all rights and emoluments in that Church. A yearly revenue of more than £100,000 sterling was voluntarily relinquished. We can quite understand how the fire of a holy enthusiasm would glitter in many an eye as they witnessed this example of the supremacy of conscience amid many temptations to compromise with the civil authorities. One great service which the disruption rendered to the common cause of Christianity was the testimony that it bore to the existence and power of a self-sacrificing attachment to the cause of Christian truth. Here was a company of nearly 500 ministers who, rather than do what they believed would be hurtful to religion, resigned their secure emoluments and threw themselves and their families upon the providence of God. The deed took many by surprise, and closed many a lip that had sneeringly proclaimed that the ministers would cling to their manses and stipends. It filled every generous mind, every lover of the noble and heroic in every land, with a glow of admiration. Whatever opinion men held of the merits of the previous controversy, the disruption itself made a deep and broad impression that the sacrifice it involved was made at the shrine of conscience. Nor was it done in the heat of a momentary impulse. It was reached by slow and well-measured steps after much public and private debate, and the truest honor is due to the men who thus rose at the call of duty above all personal, all earthly considerations.

It is necessary to notice that the Free Church thus constituted held strongly to the principle of a religious establishment. The testimony of the Church of Scotland has always been that Christ is not only Head over the Church, but also Head over nations and states as such; and it was held by the leaders of the Free Church movement, and especially by Dr. Chalmers and Hugh Miller (who as editor of the Edinburgh *Witness* did much to prepare the people for the disruption), that this doctrine of Christ's headship involved the duty of the civil magistrate to support the Church of Christ in the land over which he rules.

The distinctive principles of the Free Church may be summed up under two heads: (1) The right of those who are members of the Church, and in full communion with her, to have the uncontrolled power of choosing their own pastors. At the beginning of the conflict it was simply asked that no pastor should be intruded by a patron or by a church court upon an unwilling people, but as the battle went steadily on this claim was intensified, and the abolition of patronage was demanded as a right. The right of a call in some form or other has always been claimed by the Church of Scotland for the people. It is not necessary to review the facts on this subject; the only question is as to whether an Established Church, having no power but what the state has conferred on it, is not bound to acquiesce in the legislation of the state and the decisions of the civil courts. The Claim of Rights maintains that the restoration of patronage by the act of Queen Anne was a breach of contract as ratified in the treaty of union; but it was held, on the other hand, that the Establishment is not founded on contract at all, inasmuch as the legislature of one period can not be bound by the acts of their predecessors. That the constitution of the Church of Scotland involves the right of congregations to elect their ministers can not be doubted, and we find that after the dust of the conflict had cleared away the Church of Scotland once more, under the leadership of such men as the late Dr. McLeod and Dr. Caird, continued to claim for the people this right of electing their ministers. (2) The second great principle asserted by the Free Church was the right of the Church through its courts and under Christ, and in accordance with the word of God, to regulate all purely spiritual and ecclesiastical affairs. The Evangelical party in the Church of Scotland maintained that in matters so purely spiritual as the exercise of discipline over their own members and office-bearers they could not be interfered with by the civil courts. They were quite willing that the civil courts should assume the direction of the civil or pecuniary interests of their members, but when the court of session reviewed and reversed, declared null and void, the ordinations, suspensions, and depositions which the church courts had pronounced and ratified—when it prohibited ministers whom the church courts had appointed to preach in certain districts from exercising within these districts any function of their ministry—it was felt that the Church was stripped of her independence, and the doctrine of Christ's headship over the Church thrust aside. The appeal to the British Parliament to sustain the Church's claim to a separate and exclusive jurisdiction in things spiritual and ecclesiastical was rejected; and now it was left for those who contended for the Church's freedom and independence either to surrender the liberties and privileges which they regarded as in harmony with all the principles and statutes upon which the Kirk of Scotland was established; or to disobey the law as now declared and to submit to whatever penalties might be inflicted; or to quit the Establishment, and so relieve themselves from legal obligations which they could not conscientiously discharge. At once they chose the latter as the only open and honorable course for them to take, and rather than sacrifice the spiritual independence of the Church they paid the forfeit of their livings.

When the Free Church was thus constituted a great work was before it. Churches had to be created, provision made for the support of the ministry, a college to be organized and sustained, and missionary operations to be carried on. So much energy and zeal were put forth that within three years and a half after the disruption over $2,000,000 had been expended on churches and manses, and $350,000 had been obtained for educational purposes. In its subsequent history the Free Church has afforded the noblest demonstration of the power of a Christian Church to maintain an educated ministry, and at the same time to prosecute missionary and other benevolent enterprises with increasing liberality. The Free Church annually raises over $3,000,000 for religious purposes. Through its sustentation fund the ministers in the poorest parishes receive adequate support. Nearly all the foreign missionaries connected with the Established Church took part with the Free Church, and on this Church, even amid its own early struggles, the support of these missions devolved. It has missions in India, in Eastern Europe, in Asia Minor, Syria, and Arabia, and in Africa; it has contributed largely to the evangelization of the colonies, especially Canada and Australia; and it makes grants from year to year to evangelical societies on the continent of Europe. Free Church schools have been established through Scotland, and there are three theological colleges sustained with efficiency. Whatever may be said of the principles maintained by the Free Church, there can be only one estimate of the character and worth of the outgoing ministers, and of the zeal and liberality and success with which that Church has so far prosecuted its work. To the Alliance of the Reformed Churches, in 1892, it reported 74 presbyteries, 1,092 congregations, 1,142 ministers, and 338,978 communicants. For later and fuller statistics, and for an account of the voluminous literature of the subject, see the article PRESBYTERIAN CHURCH.

Revised by WILLIS J. BEECHER.

Free Cities: See FREE IMPERIAL CITIES.

Free Coinage: See COINAGE, CURRENCY, FINANCE, and SILVER COINAGE.

Free Congregations (transl. of Germ. *Freie Gemeinde*): the name of those formed in Germany as a rationalist reaction against the revival of positive Christianity under King Frederick William IV. of Prussia. In 1841 a number of pastors of the old rationalistic school assembled at Gnadau and Halle, under the presidency of Lebrecht Uhlich, pastor of Pömmelte, near Magdeburg, and adopted a platform of nine strongly pronounced rationalistic propositions, at the same time assuming the name "Friends of Light," or "Protestant Friends." In 1844 another meeting was held, at Coethen, where 133 theologians and about 500 laymen were present; and Uhlich delivered a lecture in which he rejected the doctrines of hereditary sin, atonement, the Trinity, the divinity of Christ, etc. At first the leaders of the movement professed to be Christians; but when afterward they openly rejected all the fundamental doctrines on which the Christian Church is built, identified themselves with the young Hegelian school, and affiliated with atheists and materialists, the Government began to interfere, and they were compelled to separate from the Church and form "Free Congregations." The movement, nevertheless, received a new and strong impetus from the political disturbances of 1848. The leaders entered Parliament, and found an opportunity of representing themselves as the leaders of the nation. The connection with politics, however, proved fatal to the movement. When the enthusiasm was spent and the heavy reaction set in, the Government began to deal in a rather peremptory way with the Free Congregations. Still in 1891 there were in Germany fifty-five of them, with 18,771 members. See F. Kampe, *Geschichte der religiösen Bewegung der neueren Zeit* (4 vols., Leipzig, 1852–60), and the annual *Freireligiöser Kalendar* (Gotha, 1871, *sqq.*).

Revised by S. M. JACKSON.

Freedman [*freed*, perf. partic. of *free* + *man*; used often as a transl. of Lat. *libertus*, *libertinus*, freedman, derivs. of *liber*, free]: in ancient Rome, a free man who had been a slave. Slaves liberated by certain forms, or owned with certain conditions before liberation, or over thirty years old at the time of acquiring freedom, became not only freedmen, but Roman citizens; others belonged to the class Latini; still others (*dedititii*) had no recognized political existence. The descendants of freedmen were free, but even when citizens they did not have the rights of the gens.

Freedmen's Bureau: a bureau of the War Department of the U. S. Government established Mar. 3, 1865, for the supervision of lands abandoned during the civil war, and for the control of all subjects relating to refugees and freedmen from any part of the territory within the operations of the army. The bureau was under the control of a commissioner appointed by the President and confirmed by the Senate. The establishing act also contained a clause authorizing a detail of officers of the army for service under the commissioner. A supplementary act enlarged the functions of the bureau so as to include "the supervision and care of all loyal refugees and freedmen, so far as the same shall be necessary to enable them, as speedily as practicable, to become self-supporting citizens of the U. S., and to aid them in making the freedom conferred by proclamation of the commander-in-chief, by emancipation under the laws of States, and by constitutional amendment available and beneficial to the public."

The work thus assigned to this bureau was nothing less than the organization into the methods of civil government of two and a half millions of people who had been driven from their former homes by the sharp vicissitudes of war. Gen. O. O. Howard, of the U. S. army, was appointed commissioner, and he at once put in motion a vast machinery for the accomplishment of the work by installing a large number of assistant commissioners in various parts of the country. These were organized into divisions as the "quartermaster's division," the "land and claim division," the "medical division," the "transportation division," the "school division," the "bounty division," and the "financial division." The scope of the work undertaken was thus defined in the report of the investigating committee of 1870: 1, taking possession, on behalf of the U. S., of all real estate abandoned by its owners; 2, taking possession of all real estate forfeited to the U. S. to be sold for taxes, whether bought in by order of the President of the U. S. or sold to settlers and others; 3, taking possession of all lands confiscated to the U. S.; 4, taking possession of all personal property of the enemy derelict, abandoned, or captured, except prizes at sea; 5, taking care of, and making provision for, all persons now freed or hereafter to be freed under any laws of the U. S. or proclamations of the President or acts of manumission; 6, taking care of all colored men in the rebellious districts who were free before the war, and of all fugitives thereto from loyal States; 7, all legal proceedings for the confiscation of property in the courts, the U. S. attorneys or special attorney to act under orders of the new department so far as respects these proceedings; 8, the administration of all laws, rules, and regulations relating to the migration of colored people; 9, and of laws relating to the compensation, if any, which the Government may hereafter give to aid loyal States in emancipating slaves; 10, all other matters relating to the emancipation and its processes, its rules and regulations, etc., and the protection of the interests of the colored men as well as of the U. S.

Within five years from the time of the organization of the bureau the school division reported the establishment of 2,118 schools with 250,000 pupils; the transportation division reported 6,352 freedmen transported to places where there was employment and assured support; the financial division reported that the receipts and expenditures for the work of the bureau proper were about $8,000,000, and that including the bounty and prize-money secured through the bureau the total amount exceeded $21,000,000. The work of the bureau was intended to be only temporary. Gradually the schools, banks, and other institutions founded for the purpose of aiding in the passage over a rough period were turned over to the common system of government in the country. The best authorities on the subject are the various reports of Gen. Howard and of the congressional committees between 1865 and 1871.

C. K. ADAMS.

Freedom of the Will: See FREE WILL and WILL.

Freehold: an estate of inheritance or for life in real property. It was in ancient times termed a frank-tenement (a word having the same meaning as "freehold"), and denoted an estate held by a freeman independently of the mere will of the feudal lord. It includes those estates to which the mode of conveyance by feoffment with livery of seizin was, in the early common law, exclusively appropriate, and this characteristic was once used as a means of defining its extent of application; but since the abolition of feoffment such a mode of description is no longer possible. (See FEOFFMENT.) But though the ceremony of livery of seizin no longer exists, the term "seizin" has still been retained as applicable to freehold interests alone, while all inferior estates are said to exist only in "possession." An estate of freehold may be either corporeal, as in land, or incorporeal, as in rents or franchises. Freeholds of inheritance are fees simple (see FEE) and fees tail. (See ENTAIL.) Freeholds not of inheritance are life estates, and may be either *conventional* (that is, such as are created by contract between the parties) or *legal* (that is, such as are created by operation of law). Those which are conventional may be either (1) for one's own life, (2) for the life of another, or (3) for some indefinite period, which may possibly last during the period of one's life. Legal life estates are (1) curtesy, (2) dower, and (3) jointure. See ESTATE, DOWER, and JOINTURE.

Revised by F. STURGES ALLEN.

Freehold: town; capital of Monmouth co., N. J. (for location, see map of New Jersey, ref. 4–E); on Cent. R. R. of N. J. and Penn. R. R.; 24 miles E. of Trenton and 16 miles W. of Long Branch. It has 6 churches, good public and private schools, a manufactory of underwear employing over 400 persons, a large iron-foundry, machine-shops, a large file-factory, a planing-mill, about 150 business places, mechanics' shops, etc., gas and electric lights, a system of sewers, and water-works supplied from artesian wells. In the town is located a handsome monument commemorating the battle of Monmouth, fought here June 28, 1778. Pop. (1880) 2,432; (1890) 2,932; (1900) 2,934.

EDITOR OF "MONMOUTH DEMOCRAT."

Free Imperial Cities: the expression generally used to translate the German phrase *freie Reichs-städte*—that is, towns which govern themselves by elected magistrates and form independent communities subject only to the emperor. They were the natural result of the unsettled state in which society found itself in the early Middle Ages, and which made it necessary for the most peaceful industry and commerce to wear helmet and sword and protect themselves by walls and towers against the robberies of the knights. As they acquired the power of defending themselves they gradually obtained political influence, and the emperor was often willing to grant them great privileges on account of the support they were capable of giving him in his quarrels with the nobility and the clergy. They first appear fully developed in their distinct character as independent members of the empire in the reign of Henry VII., 1308–13. At the Diet of Augsburg, 1474, they for the first time divided themselves into two benches—the Rhenish and the Suabian; and by the Peace of Westphalia, 1648, they were formally recognized as forming the third *collegium* of the imperial diet. Their number was always somewhat fluctuating; they seem to have lost their privileges still more easily than they gained them, and their history was generally full of violent turns. At the outbreak of the French Revolution they numbered fifty-one, the Rhenish bench comprising fourteen—Cologne, Aix-la-Chapelle (*Aachen*), Lübeck, Worms, Spires, Frankfort-on-the-Main, Goslar, Bremen, Hamburg, Mühlhausen, Nordhausen, Dortmund, Friedberg, and Wetzlar; and the Suabian, comprising thirty-seven—Ratisbon (*Regensburg*), Augsburg, Nuremberg, Ulm, Esslingen, Reutlingen, Nördlingen, Rothenburg on the Tauber, Schwäbersch-Hall, Rothmeil, Ueberlingen, Heilbronn, Gmünd, Memmingen, Lindau, Dinkelsbühl, Biberach, Ravensburg, Schweinfurt, Kempten, Windstein, Kaufbenern, Weil, Wangen, Isny, Pfullendorf, Oppenburg, Leutkerchen, Wimpfen, Weissenburg in the Nordgau, Giengen, Gengenbach, Zell on the Hammerbach, Buchhorn, Ahlen, Buchau, and Bopfingen. In 1803 there were but six—Hamburg, Lübeck, Bremen, Frankfort-on-the-Main, Augsburg, and Nuremberg, and Augsburg and Nuremberg were incorporated with Bavaria in 1806, and Frankfort-on-the-Main with Prussia in 1866. The only free cities remaining are Hamburg, Lübeck, and Bremen, which since 1861 have been sovereign members of the German empire.

Freeland: borough; Luzerne co., Pa. (for location of county, see map of Pennsylvania, ref. 3–I); on the Lehigh Valley Railroad; 39 miles by rail S. of Wilkesbarre. It has excellent schools, a planing-mill, foundry, machine-shops, etc., electric lights, water-works, and an ample supply of coal, and is the business center of the surrounding agricultural district and mining towns. Pop. (1880) 624; (1890) 1,730; (1900) 5,254.

EDITOR OF "PROGRESS."

Freeman: a man who is not a slave, or, in a narrower sense, a citizen or burgess who has certain specified rights. In ancient Rome freeman (*liberi*) were of two classes—*ingenui*, or free-born, and *liberti* or *libertini*, freedmen, who had been slaves. The two classes had a distinct legal status, but the sons of freedmen were *ingenui*, though without tribal privileges.

Freeman, EDWARD AUGUSTUS, D. C. L., LL. D.: b. at Harborne, Staffordshire, England, Aug. 2, 1823; chosen a scholar of Trinity College, Oxford, 1841; a fellow in 1845; examiner in Law and Modern History at Oxford 1857–58, 1863–64, and in the School of Modern History in 1873; became Regius Professor of Modern History and fellow of Oriel 1884. He was created honorary D. C. L. by the University of Oxford at the installation of the Marquis of Salisbury in 1870, and honorary LL. D. by the University of Cambridge in 1874; honorary member of the Imperial University of St. Petersburg 1877; honorary LL. D. of the University of Edinburgh 1884. Author of *Church Restoration* (1846); a *History of Architecture* (1849); *Architectural Antiquities of Gower* (1850); *Window-tracery in England* (1850); *Llandaff Cathedral* (1851); *Poems* (with G. W. Cox, 1850); *History of the Saracens* (1856); *History of Federal Government* (1863); *History of the Norman Conquest* (4 vols., 1867–72); *Old English History* (1869); *History of Wells Cathedral* (1869); *Historical Essays* (1871–73); *Growth of the English Constitution* (1873); *Comparative Politics* (1873); *The Ottoman Power in Europe, its Nature, its Growth, and its Decline* (1877); *The Reign of William Rufus and the Accession of Henry I.* (2 vols., 1882); *General Sketch of European History* (1872); *Disestablishment and Disendowment, what are they?* (1874); *Historical and Architectural Sketches, chiefly Italian* (1876); *Sketches from the Subject and Neighboring Lands of Venice*; *The Historical Geography of Europe* (2 vols., 1881); *English Towns and Districts*; *Lectures to American Audiences* (1883); *Chief Periods of European History* (1886); *Methods of Historical Study* (1885); *Greater Greece and Greater Britain*; *George Washington* (1888); *William the Conqueror* (1888); *The History of Sicily from the Earliest Times* (vols. i. and ii. published 1891, vol. iii. 1892); *Historical Essays* (4th series, 1892); and *Sicily* (in the *Story of the Nation* Series, 1892). D. in Alicante, Spain, Mar. 16, 1892.

Freeman, JAMES, D. D.: a Unitarian clergyman, the first in the U. S. to call himself so. By his means the "King's chapel" in Boston, the oldest Episcopal church in New England, became the first Unitarian church in New England, and consequently in America. He was born in Charlestown, Mass., Apr. 22, 1759; was graduated from Harvard College in 1777; was chosen lay-reader of King's chapel in 1782; became Unitarian; carried his people with him; induced them to alter the Prayer-book in accordance with the new theology; and in 1787 was ordained pastor of the church by the wardens and people. The connection remained unbroken till his death in Newton, Mass., Nov. 14, 1835.

Freeman, JAMES MIDWINTER, D. D.: minister and author; b. in New York city, Jan. 29, 1827; studied in the public schools and in Wesleyan University, from which he received the degree of M. A. in 1866; became a pastor in the Methodist Episcopal Church, and in 1872 editor and secretary of the Sunday-school Union and Tract Society of that Church. Between 1865 and 1870 he was the author of thirty-five books for children (under the name of *Robin Ranger*). Besides these he wrote *Use of Illustration in Sunday-school Teaching* (New York, 1867); *Handbook of Bible Manners and Customs* (1874); and *A Short History of the English Bible* (1879).

Freemasonry: a comparatively modern popular name for an ancient institution existing among all the civilized peoples of the globe, called by its votaries "Masonry," and so styled in its rituals, constitutions, and records. None but *free men* are eligible to admission (much stress has always been laid upon this fact), and its members have styled themselves "Free and accepted Masons." Hence they came to be known to profanes as Freemasons, and their society as "Freemasonry." But inasmuch as "Masonry" is the name originally adopted and still used by those professing it, it is deemed proper to treat it under that head. See MASONRY.

JOSIAH H. DRUMMOND.

Free Methodists: a small sect found chiefly in Western New York, Illinois, and Michigan. They reported in 1900 in the U. S. 870 churches, 870 ministers, and 27,629 members. See METHODISM.

Free Port: a harbor where ships of all nations may enter and leave, load and unload, without paying any duty, properly speaking; only a small toll is levied. On paying the duty stipulated the goods stored in such a place may be introduced into the country for home consumption. But the free port has its principal importance for the transit trade. See FREE PORTS in the Appendix.

Freeport: city and railway center; capital of Stephenson co., Ill. (for location of county, see map of Illinois, ref. 1–D); 121 miles W. of Chicago. It has good water-power, wheel-factories, manufactures of carriages, bicycles, vinegar,

windmills, coffee-mills, foundries, and shops of the Illinois Central Railroad. Pop. (1880) 8,516; (1890) 10,189; (1900) 13,258.
EDITOR OF "BULLETIN."

Freeport: borough; Armstrong co., Pa., (for location of county, see map of Pennsylvania, ref. 4-B); on railway and the north bank of the Allegheny river; 28 miles N. E. of Pittsburg. It has 9 churches, 8 schools, a good academy, large grist-mills, a tannery, planing-mills, sawmills, 3 very large distilleries producing 200 barrels of whisky per day, and gas-works. Pop. (1880) 1,614; (1890) 1,637; (1900) 1,754.
EDITOR OF "JOURNAL."

Free-soil Party: a former political party of the U. S.; was composed of the Liberty party of 1846, the Barnburner Democrats of New York, and of a considerable number of Northern Whigs who favored the Wilmot proviso, a proposal to prohibit slavery in the territories acquired from Mexico. In 1846 David Wilmot, a Democratic member from Pennsylvania, offered an amendment—the so-called "Wilmot Proviso"—to a bill submitted to Congress and appropriating money for the negotiation of peace with Mexico. The amendment read as follows: "Provided that there shall be neither slavery nor involuntary servitude in any territory on the continent of America which shall hereafter be acquired by or annexed to the U. S. by virtue of this appropriation, or in any other manner, except for crime, etc." It was carried in the House, but failed in the Senate; and in the next session it was defeated in both divisions of Congress. Both in the Democratic and in the Whig conventions of 1846 resolutions of the same import were offered, but in both they were rejected; and the consequence of the rejection was that a great number of prominent men, especially from Massachusetts, New York, and Ohio, seceded from both parties and formed a new party—the Free-soil Party, or the Free-soilers. In 1848, at Buffalo, they nominated Martin Van Buren and Charles Francis Adams for President and Vice-President. The ticket did not receive any electoral votes, and only 291,000 popular votes. In 1852, at Pittsburg, they nominated John P. Hale and George W. Julian, who received 157,000 popular votes. In 1856 the Free-soil party was merged into the new Republican organization.

Free Spirit, Brethren and Sisters of the: See BRETHREN AND SISTERS OF THE FREE SPIRIT.

Freethinker: a name given to the deistical writers of England in the seventeenth and eighteenth centuries. It was bestowed on John Toland, who in 1697 was called, in a letter to Locke, "a candid freethinker." In 1709 Lord Shaftesbury spoke of "our modern free writers." The title of Anthony Collins's work, written in 1713, *A Discourse of Freethinking, occasioned by the Rise and Growth of a Sect called Freethinkers*, proves that the name was then in use with a somewhat definite application. However originating, by whomsoever bestowed, it was accepted by the rationalists as descriptive of their position as men who thought freely—that is, outside of the usual lines on ecclesiastical and theological subjects. The reproach that became associated with the term in the common mind was due to the prejudice against the unbridled exercise of reason on the Christian Scriptures and Creed, whatever the special opinions professed might be. The chief names among the English freethinkers are Hobbes, Hume, Shaftesbury, Bolingbroke, Herbert of Cherbury, Tindal, Toland, Chubb, Woolston, and Collins. These names represent widely different phases of opinion, from simple deism to theism of a pure quality, and widely different intellectual attitudes, from philosophical skepticism to the blunt criticism of common sense. The freethinkers were not, strictly speaking, a sect; they entered into no league; they started no propaganda; they established no school; they put forth no creed —not even a creed of negation; they held nothing in common but a belief in the validity of reason in the sphere of faith. They were simply individual scholars, writers, talkers, who freely, with various measure of ability, uttered their doubts in regard to the system of "revealed religion." Their temper differed as widely as their genius or culture. Some were trained scholars, polished writers, wits, men of fashion, citizens of the world, men of letters, political and social philosophers; others were poor, uneducated, unrefined. Some were masters of *persiflage*; others employed none but the homeliest speech. Their deism was of every shade. For the most part they held very positive religious ideas; they stood by the broad facts of human consciousness, maintained the existence and unity of a personal God, affirmed the perfect order of the universe, and prophesied the future welfare of all mankind. There was not an avowed atheist among them, not a professed materialist, unless it were Coward. They were unanimous in their desire—apparently an earnest one—to elevate religion to a spiritual sphere, and to emancipate it from dogmatism and formalism. Lord Herbert of Cherbury, who had perhaps more influence than any other in shaping the freethinking mind of England, an elder brother of George Herbert the poet, believed the true religion to be universal, commended by its intrinsic evidence to the human mind, and attested by the intuitions of the soul. His five points of belief were the existence of one supreme God; the duty of worship; piety and virtue as the means thereof; the efficacy of repentance; the existence of rewards and punishments here and hereafter. If any, like Bolingbroke, doubted the immortality of the soul, they were actuated in part by the thoroughness of their faith in an active law of retribution, which needed no after-life for its vindication. Coward, who wrote in the spirit of a materialist, affirmed immortality as a divine gift to man, while denying that it was a natural inheritance.

Freethinking in England was colored by French infidelity, but always preserved a character of its own. The term "freethinker" is misapplied to the Frenchman of the eighteenth century, the contemporaries of Voltaire, the *esprits forts* who were the precursors of the French Revolution. These men, forced into antagonism to a despotic system in Church and state, bent all their efforts to overthrow it. Hence their vehemence of thought and speech; hence their acridity of temper; hence the audacity of their speculations, the severity of their denials, and the philosophical rigidity of their speculation. They were less freethinkers than aggressive thinkers. To them the name *doctrinaire* applies. They did aim at propagandism; they did attempt to form a school; they constituted an aristocracy of intellect, a clique of philosophers. They had little sympathy with the common mind, and little faith in the intuitions of the common heart. For English common sense they substituted Parisian wit, and for English seriousness Gallic levity. The English freethinker pushed his inquiries into the wide field of religious speculation; the French *esprit fort* took up an ultimate position outside of all religious confessions, and defended it. Both the Englishman and the Frenchman were by their principles compelled to be champions of human rights. The former expressed the spirit of sturdy self-reliance that characterizes the British mind; the latter, in contending against oppression in Church and state, advocated principles that afterward bore fruit in the Revolution that laid Church and state prostrate. Still the spirit of the Englishman was more democratic.

The term "freethinker" is even less applicable to men like Strauss, Paulus, Baur, and the German rationalists than to Diderot, d'Holbach, d'Alembert, and Voltaire. For these men, though professing in some respects the same opinions with the Englishmen, arrived at them by different methods, and held them in a different spirit. Closet-students, scholars, and philosophers by profession, they published the result of their labors in a calmly scientific temper, as if unaware of opposing powers. They did not plume themselves on their freedom: they were not apostles of liberty; they made no war on institutions. The Englishman is the only genuine freethinker. The Frenchman is a *philosopher*—the German is a *rationalist*. Both are in advance of the freethinker in clearness of thought and statement, nicety of discernment, and adequacy of learning. The freethinker belongs to the last generation. The scientific thinker, the true thinker, is taking his place. For the history of freethinking, see Lechner, *Geschichte d. Deismus*, and Adam Storey Farrar, *Critical History of Free Thought*.

Freetown: a town of Western Africa, in lat. 8° 29′ N., lon. 13° 9′ W.; capital of the British colony of Sierra Leone; on the southern shore of the estuary of the Sierra Leone river, in a low, hot, but extremely fertile and beautiful plain, and surrounded by an amphitheater of lofty, forest-clad mountains (see map of Africa, ref. 5-A). The great amount of decomposed or half-decomposed vegetable matter which the river carries down to the sea, and which the tide drives back toward the city, makes the place unhealthful and unsuitable for European residents. The city is well built, though most of its houses are of wood. As each house or hut has its garden, or at least its courtyard, the city occupies a large area in comparison with the number of its inhabitants. Pop. 30,000.

Free Trade: literally, trade or commercial intercourse free from artificial interference or restriction. As generally used, however, the term has a wider and more complex meaning, and may be regarded as the expression of a principle of political economy which holds that the prosperity of a state or nation can best be promoted by freeing the exchange of all commodities and services between its own people, and between its own people and the people of other nations and countries, to the greatest extent possible, from all interferences and obstructions; but more especially from interferences and obstructions of an arbitrary, artificial character, resulting from legislation or prejudice. Free trade, as an economic principle or politico-commercial system, moreover, is the direct opposite to the so-called principle or system of *protection*, which maintains, on the contrary, that a state or nation can most surely and rapidly attain a high degree of material prosperity by "protecting" or shielding its domestic industries from the competitive sale or exchange of the products of all similar foreign industries; the same to be effected either by direct legislative prohibition of foreign commerce, or by the imposition of such discriminating taxes on imports as shall, through a consequent enhancement of prices, interfere to a greater or less extent with their introduction, free exchange, and consumption. An explanation of either of these terms, therefore, involves a presentation of the arguments, based on theory or experience, which may be adduced in support of the respective economic systems for which they are the expressions, and a review of the premises of the one almost necessarily requires a conjoint statement of the claims of the other.

It is also essential to appreciate clearly, at the outset of any explanation, the relation which "free trade" and "protection," regarded as economic systems, sustain to the subject of taxation and revenue—a matter about which there is no little of popular misconception. The nature of this relation may be stated as follows: The command of revenue being absolutely essential to the existence of organized government, the power to compel contributions, or, as it is termed, "to tax," is inherent in every sovereignty, and rests upon necessity, and upon no other rational basis. And if this premise is correct, the conclusion is warranted that the righteousness of any specific tax, or interference on the part of the state with individual rights of property, may be tested by the question "is it necessary" for fulfilling the rightful purposes of the state, not is it convenient, nor is it suitable. If it is necessary, the power of taxation may be justifiably exercised to any extent. But if the interference transcends such necessity, if it takes a dollar of a citizen's property beyond the requirements of the necessity, the act of taking loses at once its sole justification—i. e. that of necessity—and becomes tyrannical. Further, if the state, even to promote its necessary and legitimate objects, takes the amount of property to which it is entitled in such an unequal and inequitable manner that one citizen pays more than his just share of the requisite amount—whether it be great or small—it takes that to which it has no right, or does that which if done by a citizen in defiance of law is called robbery. Again, let the true ends of civil government be what they may, the acquirement of wealth is not one of them. Government, however, needs money, not in the ordinary sense of riches, but as the indispensable and practically the only means of defraying its expenditures; and taxation is the process of obtaining it from the citizen, who in turn obtains it in exchange for some product of his work, or for some direct personal service. The obligations of the government of any civilized state can not be discharged by the tender of ordinary merchandise, or by the mere framing of a statute or the wording of a law. The only instrumentality by which these results can be accomplished is money, and the raising of money is one thing and the distribution or use of it after it has been raised is another and entirely different thing. That the state, through its legislative department, and with a view of promoting what it considers to be a public purpose or for general good, "may interfere with the laws of trade, repress one form of industry and stimulate another, discourage even to the extent of prohibition the indulgence of certain tastes and practices which it may judge detrimental to itself or its citizens, and expend the money raised by taxation in furtherance of such objects," may not be denied. But at the same time, if it is sought to make taxation, which is a fit contrivance only for raising money, an instrument for effecting some ulterior purpose, be it never so just and desirable—as, for example, the regulation of trade and industry, the enforcement of morality, or for punitive purposes—is to distort an agency from its sole fit object to one that is less fit, and lose sight in so doing of the fundamental principles of every free government. The phrase "taxation for revenue only" has a broader and deeper meaning, therefore, than is generally recognized by those who use it in political discussion, and is really in the nature of an axiom in political economy and civil polity, subject to such limitations as the recognition of this axiom involves and requires. The question as to what forms taxation had best assume becomes a mere question of experience and expediency, preference being always given to those forms which involve the least waste, cost, and personal annoyance in collection, which are most productive in revenue, and which interpose the minimum of interference and restriction on the interexchange of commodities and services. Free trade as an economic principle is not therefore, as is often assumed and supposed, antagonistic to the imposition of equitable duties on imports, provided the end sought to be attained is simply revenue, and the circumstances of the state render such form of taxation expedient. Protection, on the other hand, on the ground of advantages accruing directly or incidentally, advocates and defends the exercise of the power of taxation for purposes other than revenue, or the procurement of money for defraying the necessary expenditures of the State; and indeed for purposes which avowedly contemplate, and can only be successfully attained by the restriction or entire prevention of revenue. Protection, in fact, to the exact extent to which it attains its main object—i. e. the taxation of imports—is obviously always and necessarily antagonistic to revenue, inasmuch as revenue is received only on those commodities which *come in*, while protection is secured only when the importation of commodities is restricted or made impossible. The adjustment of a tariff for revenue in such a way as to afford what is termed "incidental protection"—an idea much favored by politicians in the U. S.—is based on the supposition that by arranging a scale of duties so moderate as only to restrict and not prevent importations, it is possible to secure a sufficiency of revenue for the state, and at the same time stimulate domestic manufactures by increasing the price of competitive foreign products. That the double object thus aimed at is capable of attainment can not be doubted, but that the project is also one of the most costly of all methods of raising revenue will appear evident if it is remembered that, while revenue to the state accrues only from the tax levied on what is imported, the tax arising from the increase of price is paid equally by the nation upon all that is sold and consumed in competition with the foreign article. A tariff for revenue so adjusted as to afford incidental protection is therefore a system which requires the consumers, that is, the people, to pay much in order that the state may receive little.

With these preliminary statements the essential points of the argument in favor of free trade as contradistinguished from protection may be stated as follows:

1. The highest right of property is the right to exchange it for other property. In the absence of all freedom of exchange between man and man civilization would obviously be impossible; and it would also seem to stand to reason that to the degree in which we impede or obstruct the freedom of exchange—or, what is the same thing, commercial intercourse—to that same degree we oppose the development of civilization.

2. Any system of law which denies to an individual the right freely to exchange the products of his labor, by declaring, as is generally the custom, that A, a citizen, may trade on equal terms with B, another citizen, but shall not under equally favorable circumstances trade with C, who lives in another country, reaffirms in effect the principle of slavery, for both slavery and the artificial restriction or prohibition of exchanges deny to the individual the right to use the products of his labor according to his own pleasure, or what may seem to him the best advantage; or, in other words, the practical working of both the system of human slavery and the system of protection is to deprive the individual of a portion of the fruits of his labor without making in return any direct compensation. The argument that is generally put forth by the advocates of protection in justification of legislation restricting freedom of exchange, or

in defense of the pithily expressed proposition "that it is better to compel an individual to buy a hat for five dollars, rather than to allow him to purchase it for three," is that any *present* loss or injury resulting from such restriction to the individual will be more than compensated to him *indirectly* as a member of society or citizen of the state. But this plea is the same in character, and just as legitimate, as that which was formerly put forth in defense of the system of Negro slavery—namely, that the system was really for the good of the persons enslaved, and that any suffering or deprivation endured by the slave for the good of society—meaning thereby the masters—would be fully compensated to him, through moral discipline, in the world to come. It is also to be noted that this same species of argument—i. e. indirect or future individual or society benefit as a justification for present personal restriction or injury—has always been made use of in past ages as a vindication and in warrant for persecution on the part of the state for heresy or unbelief, and also for the establishment of state religions and enforced conformity thereto.

3. The general result for which all men labor is to increase the abundance or diminish the scarcity of those things which are essential to their subsistence, comfort, and happiness. Different individuals have different aptitudes, or are endowed with different natural capacities for making the various forces of nature and varieties of matter available for production. One man is naturally fitted to excel as a farmer, another as a mechanic, the third as a navigator, the fourth as a miner, engineer, builder, or organizer and director of society, and the like. The different countries of the earth likewise exhibit great diversity as respects soil, climate, natural products, and opportunity. It would seem clear, therefore, in order that there may be the greatest material abundance, that each individual shall follow that line of production for which he is best fitted by natural capacity or circumstances; and that, for the determination of what that line must be, the promptings of individual self-interest and experience are a far better guide than any enactments of legislatures and rulers possibly can be; and, finally, that the greatest possible facility be afforded to producers for the interchange of their several products and services. So true, indeed, are these propositions that mankind in their progress from the rudest and most incipient social organizations to higher degrees of civilization invariably act in accordance with them, and, as it were, instinctively. It is important at this point to recognize clearly the meaning of the term *industry*, which in its "domestic" form is claimed to be the special object of protection to protect, and which the advocates of the protection theory seem to very imperfectly appreciate. Thus industry consists of two factors, or there are two elements in it. One is production (Lat. *pro*, forward, and *ducere*, to lead), in the sense of drawing out materials or products from natural sources, and the other is exchanging or selling the things produced; and industry can not get along without both any more than a man can get along with only one leg. If a farmer grows 10,000 bushels of corn, and needs only 1,000 bushels for himself, family, and animals, and can not exchange or sell the other 9,000, he might as well have not raised it. He can eat corn, burn it for fuel, and make whisky of it, but he can not clothe himself with corn husks, plow with a corn stalk, wear corn shoes, and the like. To get these other things he must sell or exchange his surplus 9,000 bushels; and he must be of a simple mind who does not at once see that the greater facilities afforded to him for exchange, such as good roads, bridges, horses and wagons, cheap and swift railways and steamships, low tolls, freights and taxes, the greater will be the opportunity for exchange and trade to advantage. On the other hand, poor roads, unbridged streams, few or no railways or steamships, and high tolls, freights, and taxes, all tend to restrict or destroy trade and the opportunity to sell his 9,000 bushels of corn to advantage. In short, there has never been a case in all human experience when the removal of restrictions—natural or legislative—on trade did not result in the extension of trade to the mutual advantage of the great majority of the people concerned; and, on the other hand, there has never been a case where trade has been restricted by mountains, seas, bad roads, or tolls, or tariff taxes, in which trade has not decreased, or not developed, to the great disadvantage of the great majority. The man who can get a law passed that will enable him to tax trade or exchange always sees an advantage to himself in the restricted trade that will result. So also does the man who sits behind a bush on the road, with a gun, and tells the farmer who has sold his surplus 9,000 bushels of corn, "You can not pass unless you give me a big part of what you received for it in exchange." Carry out logically and to their fullest extent the accepted and popular views about protection, we would have every man trying to produce as much and sell as little as possible. Free exchange between man and man—or, what is the same thing, free trade—is therefore action in accordance with the teachings of nature. Protection, on the other hand, is an attempt to make things better than nature made them. Free trade, or the interchange of commodities and services with the minimum of obstruction, by rendering commodities cheap, tends to promote abundance. Protection, by interference or placing obstructions in the way of exchanges, tends to increase the cost of commodities to the consumer, and thereby promotes scarcity.

All the people of the U. S. instinctively rejoice at the announcement of every new discovery in the construction or propulsion of vessels, whereby the time and cost of transporting commodities across the Atlantic from Liverpool to New York, or across the Pacific from China and Japan to San Francisco, are diminished; and yet they do not revolt at the inconsistency of imposing taxes, for purposes other than to meet the necessities of the state, on the landing of the commodities thus transported; which are precisely equivalent in effect, as regards the consumer, to substituting slow-sailing vessels of small tonnage in the place of ocean steamers, or of so widening the expanse of ocean to be traversed that the time employed in transportation (and the consequent increased cost of freight and risk) shall be expressed by months rather than by days. A few illustrations derived from the actual experience of the U. S. are here pertinent to the argument.

Upon the coast of Nova Scotia, within a short distance of the U. S., there are coal mines of great value, as respects quantity and quality, which, unlike any others in the whole world, are located so advantageously in respect to ocean navigation that almost by the action of gravity alone the coal may be delivered from the mouth of the pit upon the deck of the vessel. For many years the Government of the U. S. imposed a tax of $1.50 per ton on the landing of this coal within its territory. Now, if we assume that coal upon a well-managed railroad can be transported for one cent per ton per mile, the effect of this tax upon the people of New York and New England is precisely equivalent to a removal of these coal mines of Nova Scotia from a point on the seaboard to a location 150 miles inland. But it would also seem to stand to reason that if the removal of these mines 150 miles into the interior was a benefit to the people of the U. S., a further augmentation of their distance from the seaboard to 500 or 1,000 miles would be a still greater blessing, and that their absolute annihilation would be the most superlative good of all.

Again, about 1850 a British engineer, Bessemer, devised a new process for the manufacture of steel. He did not claim to make anything new; he did not claim to make steel of a quality superior to what was made before; but he did succeed in showing mankind how to make an indispensable article in the work of production *cheap* which was before *dear*. Immediately on the assured success of the invention the advocates of protection in the U. S. asked Congress to impose such a duty on the import of this steel as would, through a consequent increase of its price to American consumers, almost completely neutralize the only benefit accruing from the knowledge and use of the new process—namely, its *cheapness*—and succeeded in obtaining a duty that in a great degree accomplished such a result.

From the above propositions and examples it would seem evident that the direct effect of a protective duty, when it is really operative, is to compel, on the part of the community employing such an agency, a resort to more difficult and costly conditions of production for the protected article; and also that when a state or community adopts the protective policy it also commits itself to the indorsement of the principle that the development and multiplication of obstacles is equivalent to, or the surest method of, developing or multiplying riches—a policy and a principle which, if logically and practically carried out, would lead to disuse of all labor-saving machinery.

The advocate of protection, however, meets this averment, as well as the argument embodied in the coal and Bessemer-steel illustrations above given, by saying that by prohibiting or restricting the importation and use of foreign coal and steel a demand will be created for a corresponding additional quantity of similar products of the U. S. The immediate result of this will be that an additional opportunity will in consequence be afforded to citizens of the U. S. desirous of following the occupations of coal-miners or transporters or steel-makers; and, the results of their labor and expenditure remaining in the country, the national wealth will be thereby augmented, whereas if the same amount of labor and expenditure is diverted to, and takes place in, a foreign country, the results will be exactly opposite.

In answer to this it may be said: (1) That the amount of consumption in the two instances, and consequently the results of consumption, will not be the same; for whatever increases the price of a useful commodity diminishes its consumption, and, *vice versa*, whatever diminishes the price increases consumption. (2) To admit the desirability of creating an opportunity of employing labor through the agency of a tax on all consumers of coal and steel to do work that would yield to the same consumers a greater product of the same articles if performed elsewhere, or an equal product at less cost, is to admit that the natural resources of a country are so far exhausted that there is no opportunity for the truly productive employment of labor—an argument which, however effective in overpopulated countries, can have no possible application in a comparatively new country like the U. S., whose natural resources, so far from being exhausted, are yet, as it were, unappropriated and unexplored. Again, a tax levied in pursuance of legislative enactment for the maintenance of such labor is clearly in the nature of a forced charity, while the petitioners for its enactment answer in every particular to the definition of the term "pauper"—namely, one who publicly confesses that he can not earn a living by his own exertions, and therefore asks the community to tax themselves or diminish their abundance for his support. (3) The only true test of the increase of national wealth is the possession of an increased quantity of useful things in the aggregate, and not in the amount of labor performed or the number of laborers employed, irrespective of results. A tariff from its very nature can not create anything; it only affects the distribution of what already exists. If the imposition of restrictions by means of taxes on imports enables a producer to employ a larger number of workmen and give to them better wages than before, it can be accomplished only at the expense of the domestic consumers who pay increased prices. Capital thus transferred is no more increased than is money by transference from one pocket to another, but on the contrary is diminished to just the extent that it is diverted from employing labor that is naturally profitable to that which is naturally unprofitable. And herein is exposed the fallacy of the averment that duties levied on the import of foreign commodities protect home industry. It may be conceded that certain industries, as the result of such duties, may be temporarily stimulated, and the producers obtain large profits by a consequent increase in the price of their products; but then it is at the expense of those who pay the increased price, who are always the domestic consumers.

To further make clear this position, the following illustration, drawn from actual experience, is submitted: For a number of years subsequent to 1865 the Government of the U. S., with a view of protecting the U. S. producer, imposed such a duty on foreign salt as greatly to restrict its importation and at least double the price of the article, whether of foreign or domestic production, to the consumer. The result was, taking the average price of No. 1 spring wheat for the same period in Chicago, that a farmer of the West desirous of buying salt in that market would have been obliged to give 2 bushels of wheat for a barrel of salt, which without the tariff he would have readily obtained for a bushel. If, now, the tax had been imposed solely with a view to obtaining revenue, and the farmer had bought imported salt, the extra bushel given by him would have accrued to the benefit of the state; and if the circumstances of the Government required the tax, and its imposition was expedient and equitable, the act was not one to which any advocate of free trade could object. But in the case in question the tax was not imposed primarily for revenue, as was shown by the circumstance that imports and revenue greatly decreased under its influence, and the salt purchased by the farmer in Chicago was domestic salt, which had paid no direct or corresponding tax to the Government. The extra bushel of wheat, therefore, which the farmer was compelled to give for his salt accrued wholly to the benefit of the domestic salt-boiler, and the act was justified on the ground that domestic industry, as exemplified in salt-making, was protected. And yet it must be clear to every mind that if the farmer had not given the extra bushel of wheat to the salt-boiler he would have had it to use for some other purpose advantageous to himself—to give to the shoemaker, for example, in exchange for a pair of brogans. By so much, therefore, as the industry of the salt-boiler was encouraged that of the farmer and the shoemaker was discouraged; and, putting the whole matter in the form of a commercial statement, we have the following result: Under the so-called "protective system" we have a barrel of salt and 2 bushels of wheat passed to the credit of what is called "home industry," while under a free system we have a barrel of salt, 2 bushels of wheat, and a pair of shoes. Protection, therefore, seeks to promote industry at the expense of the products of industry; and its favorite proposition, that though under a system of restriction a higher price may be given for an article, yet all that is paid by one is given to some other person in increased employment and wages, has this fallacy—namely, that it conceals the fact that the price paid by the consumer would have been equally expended upon something and somebody if the consumer had been allowed to buy the cheap article instead of the dear one; and consequently the loss to the consumer is balanced by no advantage in the aggregate to any one. "When a highwayman takes a purse from a traveler he expends it, it may be, at a drinking-saloon, and the traveler would have expended it somewhere else. But in this there is no loss in the aggregate; the vice of the transaction is that the enjoyment goes to the wrong man. But if the same money is taken from the traveler by forcing him to pay for a dear article instead of a cheap one, he is not only despoiled of his just enjoyment as before, but there is a destructive process besides, in the same manner as if the loss had been caused by making him work with a blunt ax instead of a sharp one. Whenever, therefore, anything is taken from one man and given to another under the pretense of protection to trade, an equal amount is virtually thrown into the sea, in addition to the robbery of the individual."

To render the illustration derived from the transaction in salt, above given, more complete, attention is asked to the following additional historical circumstances: In the valley of Kanawha, West Virginia, there are salt-springs which furnish brine in abundance and of great strength and purity. The same springs also furnish conjointly an inflammable gas, which flows with such force and quantity that it is used both to lift the salt-water into tanks at considerable elevation and to subsequently evaporate the brine by ignition under the furnaces, without the necessity of resorting to the use of any other fuel whatever. Salt at this point can therefore be produced at a nominal cost, and with advantage even over solar evaporation, inasmuch as all expense of pumping the salt-water into vats in the first instance is entirely obviated. During the civil war, in order to deprive the army and the people of the Southern Confederacy of a supply of salt, the springs in question at Kanawha were temporarily destroyed by the Federal forces; and an important natural supply of salt to the country being thus cut off, the manufacturers of salt in Ohio, from springs less advantageously productive, obtained for a time a larger market and higher prices for their more costly competitive products. With the close of the war and the reopening of the Kanawha salt-works, the advantages thus gained at the expense of the salt-consumers bid fair to be put an end to; but in order to perpetuate them the Ohio salt-manufacturers united, and, having at a large annual expense leased the Virginia springs, abandoned and absolutely forbade their utilization.

4. As has been already shown, any increase in the price of domestic products consequent on the imposition of taxes on the importation of corresponding products of foreign origin is paid by the domestic consumer. Hence a result alike deducible from theory and proved by all experience—that not only does protection to a special industry not result in any benefit to the general industry of a country, but also that its beneficial influence on the special industry itself is not permanent, but temporary. Thus all taxes tend to diffuse themselves, and, if levied permanently and with any degree of uniformity, do diffuse themselves almost with infallibility. The price of no article can be permanently advanced by artificial agencies or otherwise without an effort on the part of every person directly or indirectly concerned in its consumption to protect and compensate himself by advanc-

ing the price of the labor or products he gives in exchange. If sufficient time is afforded, and local exchanges are not unduly restricted, this effort of compensation is always successful. Hence from the very necessity of the case no protective duty can be permanently effective; hence, also, it is that protected manufacturers in every country always proclaim, and no doubt honestly feel, that the abandonment of protection, or even its abatement, would be ruinous. Of this the experience of the U. S. affords a most curious and convincing illustration. Thus in 1862–63, in order to meet the expenses of a great war, the Government imposed excise or internal taxes on every variety of domestic manufactures, and, in accordance with the principles of equity, imposed what were claimed to be corresponding taxes on the importation of all competing foreign products. Soon after the close of the war, however, when the cessation of hostilities diminished the necessity of so large revenues, the internal taxes were all repealed, but in no one instance was there a protected manufacturer found who took any other position than that a repeal of the corresponding tariff would be most disastrous to his business. The tariff, as originally raised to compensate for the new internal taxes, was therefore left in a great degree unchanged. That the principle here laid down, of want of permanency in protective agencies, is furthermore admitted by the protected manufacturers themselves as a result of their own experience, is also proved by the following striking testimony forced out under oath before a Government commission from one of the foremost of their number in 1868—the late Oakes Ames, of Massachusetts:

Question.—What, according to your experience, was the effect of the increase of the tariff in 1864 on the industries with which you are specially acquainted? *Ans.*—The first effect was to stimulate nearly every branch—to give an impulse and activity to business; but in a few months the increased cost of production and the advance in the price of labor and the products of labor were greater than the increase of the tariff, so that the business of production was no better, even if in so good a condition, as it was previous to the advance of the tariff referred to.

The result of the fourteen revisions or modifications of the tariff of the U. S. that were made between 1861 (when through the necessities of war a comparatively liberal commercial policy was abandoned) and 1891 (an era of peace and great debt reduction) was as follows: The average *ad valorem* rates on the import of dutiable commodities were progressively and largely advanced, and mainly, after the termination of the war in 1865, on the plea that the domestic industries of the country required additional protection. For example, from an average of 18·84 per cent. in 1860 to 36·69 per cent. in 1864, 40·69 per cent. in 1875, and 46·28 per cent. in 1890–91. Henry C. Carey, in an essay *On Wealth*, published in 1838, thus clearly and cogently expressed himself on this question: "The moment," he says, "we admit that taxation in *any case* tends to promote industry, it is impossible to say where we shall stop. If taxation be a stimulus the advantage must increase with its extent, as taking 2*s.* per week must do more good than taking 1*s.* If taxation be good, so is the lash; both will make people work, but neither will make them work well."

5. Upon no one argument have the advocates of protection relied more in support of their system than that contained in the assumption already referred to—that if there were no restrictions on trade the opportunity to labor created by protection, and the results of the expenditure of the earnings of such labor, would be diverted to other countries to their benefit, and to the corresponding detriment of that country which, needing protection by reason of a necessity for paying higher wages or other industrial inequalities, abandons it; or, to speak more specifically, it is assumed that if the U. S. were to adopt a policy of free trade, England would supply us with cotton and metal fabrications; Germany, with woolen goods; Nova Scotia, with coal; the West Indies, exclusively with sugar; Russia, with hemp and tallow; Canada, with lumber; and Australia, with wool—that thereby opportunity to our own people to labor would be greatly restricted, and the wages of labor reduced to a level of the wages of foreigners. Specious as is this argument, there could not be a greater error of fact or a worse sophism of reason. None of the commodities mentioned will be given by the producers resident in foreign countries for nothing. *Product for product* is the invariable law of exchange, and we can not buy a single article in any market except with or by a product of our own, or for money which has been obtained by the exchange of some product for it. Nothing, therefore, can or will be imported unless that in which it is paid for can be produced at home with greater final advantage. Hence also it is in the nature of a truism to assert that it is for the interest of every community that its industry should be directed to the production of such articles as are attended with greater final advantage, in preference to those which are attended with less; as inevitably would be the result if the business of production and exchange were not obstructed by legislative enactments, but left to the guidance of individual self-interest.

From these premises we are warranted in regarding the following deductions as in the light of economic axioms: 1. A nation or community can attain the greatest prosperity, and secure to its people the greatest degree of material abundance, only when it utilizes its natural resources and labor to the best advantage and with the least waste and loss, whatever may be the nominal rate of wages paid to its laborers. The realization of such a result is hastened or retarded by whatever removes or creates obstructions or interferences in the way of production and exchanges. 2. The exports on the whole of any country must and always do balance its imports, which is equivalent to saying that if we do not buy we can not sell, while neither buying nor selling will take place unless there is a real or supposed advantage to both parties to the transaction. 3. As a nation exports only those things for which it possesses decided advantages relatively to other nations in producing, it follows that what a nation purchases by its exports it purchases by its most efficient labor, and consequently at the cheapest possible rate to itself. Hence the price paid for every foreign manufactured article, instead of being so much given for the encouragement of foreign labor to the prejudice of our own, is as truly the product of our own labor as though we had directly manufactured it ourselves. Free trade, therefore, can by no possibility discourage home labor or diminish the real wages of laborers.

The favorite protectionist argument, that if trade is unrestricted, and the people of a country, under the inducement of greater cheapness, are allowed to supply themselves with foreign commodities, the opportunities for the employment of domestic labor will be correspondingly diminished, is an argument identical in character with that which has in past times often led individuals and whole communities to oppose the invention and introduction of labor-saving or "labor-dispensing" machinery. To sift thoroughly this sophism, it is sufficient to remember that labor is exerted not for the sake of labor, but for what labor brings, and that human wants expand just in proportion to the multiplication of the means and opportunity of gratifying human desires. If the wages of a day's labor would purchase in the market one hundred times as much as at present, can any one doubt that the demand for the necessaries and luxuries of life would be increased a hundredfold? If the people of the U. S. could obtain the products of the labor of other countries for nothing, could the labor of the whole world supply the quantity of things we should want? In short, the demand for the results of labor can never be satisfied, and is never limited except by its ability to buy; and the cheaper things are the more people will purchase and consume. Nothing, therefore, can be more irrational than the supposition that increased cheapness, or increased ability to buy and consume, diminishes or restricts the opportunity to labor. If by the invention of machinery or the discovery of cheaper sources of supply the labor of a certain number of individuals in a department of industry becomes superfluous or unnecessary, such labor must take a new direction, and it is not to be denied that in the process of readjustment temporary individual inconvenience, and perhaps suffering, may result. But any temporary loss thus sustained by individuals is more than made up to society, regarded from the standpoint of either producers or consumers, by the increased demand consequent on increased cheapness through greater material abundance, and therefore greater comfort and happiness. About the time of the invention and introduction of the sewing-machine into Europe the benevolent people of a city in Germany where the industry of needlewomen was a marked specialty formed an organization to lessen in a degree the injury which it was believed would inevitably accrue from the supplementation of a great opportunity to labor by the poor which was threatened. After the lapse of a few years, however, when society, as represented by the whole people of the city, obeying their natural instincts, had determined to have, and had obtained, a cheaper source of supply for their needle-products than before, the organization referred to instituted an investigation, the result of which showed that by reason of a greater consumption of sewed goods, consequent on their cheaper supply, the number of persons engaged in the operating of sewing-machines was greater than what had formerly found employment by the needle, and that wages had increased rather than diminished.

6. The averment that prohibition or restriction of foreign imports encourages diversity of domestic industry is answered by saying that when any trade can be introduced or undertaken for fiscal or public advantage private enterprise is competent to its accomplishment. "To ask for more is only to ask to have a finger in the public purse." It may be possible to conceive of specific cases in which it might be politic for a government to give an advantage for a limited time and for a definite object. But protection, as an economic system, can not rightfully claim any support from such an admission, inasmuch as its demand is that the public shall be obliged to support all manufacturing enterprises upon no other ground but that they can not support themselves.

Furthermore, whenever governments have attempted to establish or stimulate industries by the payment of bounties, the general and ultimate result has been found to be that the industry is prosecuted mainly for the bounties, and that the bounty has been a stimulus to extensive fraudulent practices.

7. Protection, it is alleged, has a tendency to make what are termed manufactured products cheaper. A very fit and cogent answer which has been made to this assertion of the opponents of free trade is that if protection is to be recommended because it leads ultimately to cheapness, it were best to begin with cheapness. Another answer is to be found in the circumstance that not a single instance can be adduced to show that any reduction has ever taken place in the cost of production under a system of protection, through the agencies of new inventions, discoveries, and economies, which would not have taken place equally soon under a system of free trade; while, on the contrary, many instances can be referred to which prove that protection, by removing the dread of foreign competition, has not only retarded invention, but also the application and use of improvements and inventions elsewhere devised and introduced. Thus, referring to the experience of the U. S., where the system of protection has in general prevailed for many years, it is a well-known fact that the department of industry which has been distinguished more than any other by the invention and application of labor-saving machinery is that of agriculture, which has never been protected to any extent; and for the reason that the country which raises a surplus of nearly all its agricultural products for sale in foreign countries never can be. On the other hand, in that department of industry engaged in the primary manufacture of iron, which has always been especially shielded by high restrictive duties, not only from foreign competition, but also from the necessity of the exercise of economy and skill, the progress in the direction of improvement has been so slow that according to the report of the geological survey of Ohio for 1872–73 there was at that time hardly a furnace in that great iron-producing State that could be compared with the best European furnaces, in construction, management, or product, many Ohio furnaces unnecessarily wasting one-fourth of the metal in the ore in the process of smelting.

It is also pertinent to this department of the subject to notice the idea adopted by a school of U. S. economists or politicians that it is for the advantage of a country to endeavor to effect a reduction of prices by the creation, through legislation or otherwise, of an excessive or artificial stimulus to production. That the creation of an artificial stimulus to domestic production—such as is almost always temporarily afforded by an increase of the tariff or by war, which necessitates extraordinary supplies—does have the effect in the first instance to quicken certain branches of production, and subsequently reduce prices through the competition engendered, can not be doubted; but experience shows that in almost every such instance the reduction of prices is effected at the expense or waste of capital, and that the general result, in place of being a gain, is one of the worst events that can happen to a community. Thus the first effect of creating an extraordinary domestic demand is to increase prices, which in turn affords large profits to those in possession of stock on hand or of the machinery of production ready for immediate service. The prospect of the realization of large profits next immediately tempts others to engage in the same branch of production—in many cases with insufficient capital, and without that practical knowledge of the details of the undertaking essential to secure success. As production goes on, supply gradually becomes equal to, and finally in excess of, demand. The producers working on insufficient capital or with insufficient skill are soon obliged, in order to meet impending obligations or dispose of inferior products, to force sales through a reduction of prices, and the others, in order to retain their markets and customers, are soon compelled to follow their example. This in turn is followed by new concessions alternately by both parties, which are accompanied by the usual resort of turning out articles or products of inferior quality, but with an external good appearance—slate being substituted in the place of coal; cinder in the place of iron; shoddy in the place of wool; starch and sizing in the place of cotton; pasteboard in the manufacture of boots and shoes in the place of leather; and clay in the manufacture of paper in the place of fiber. And so the work of production goes on, until gradually the whole industry becomes depressed and demoralized, and the weaker producers succumb, with a greater or less destruction of capital and waste of product. Affairs having now reached their minimum of depression, recovery slowly commences. The increase of the country causes consumption to gain gradually on production, and finally the community suddenly becomes aware of the fact that supply has all at once become unequal to the demand. Then those of the producers who have been able to maintain their existence enter upon another period of business prosperity; others again rush into the business, and the old experience is again and again repeated. Such has been the history of the industry of the U. S. under the attempt to restrict the freedom of trade by high duties on imports, frequently modified; and such also was the effect of the war from 1861–65. To use a familiar expression, it has always been either "high water" or "low water" in the manufacturing industry of the country—no middle course, no stability. What the people have gained at one time as consumers from low prices they have more than compensated at another by the recurrence of extra rates, and as producers by periodical suspensions of industry, spasmodic reduction of wages, and depression of business.

Meantime the loss to the country from the destruction of capital and the waste and misapplication of labor has been something which no man can estimate. One of the most striking illustrations of this experience, selected from many examples afforded by the U. S., is the following: In 1864–65 it was found that the supply of paper of domestic manufacture was insufficient to meet the consumption of the country, and that the supply from abroad was greatly impeded by an unusually heavy duty imposed in time of war on its import. The price of paper in the country accordingly rose with great rapidity, and the profits of the paper-manufacturers who were then in possession of the machinery of production became something extraordinary. The usual effect followed. A host of new men rushed into the business and old manufactories were enlarged, so that during the years 1864–66 it was estimated that more paper-mills were built in the U. S. than during the whole of the twelve years previous. As a matter of course, the market became overstocked with paper, prices fell with great rapidity, many abandoned the business through inclination or necessity, and many mills and much machinery were sold for less than the cost of construction; while in the spring of 1869 the paper-makers met in convention to consider the desirability of decreasing the production of paper—or, what is the same thing, of allowing their capital and their labor to remain unemployed—on account of the unprofitableness of the business. In October of the same year a storm of great violence swept over the northern portion of the country, and in the flood which followed many mills engaged in the manufacture of paper were so injured as to temporarily render them incapable of working. A leading journal in one of the paper-manufacturing districts, devoted to the advocacy of protection, in commenting on the effects of the storm, used this language: "There seems to have been unusual fatality among paper-mills, but this disaster will work to the advantage of those who escaped the flood, and we doubt not that those that did stand will do a better business in consequence of the lessened supply"; or, in other words, the condition of this particular industry had become so bad through the influence of a fiscal policy based on the theory of protection that the occurrence of a great public calamity, with a vast attendant destruction of property, had come to be regarded in the light of a public blessing.

One notable result of intense competition among producers, more especially of manufactured products, has been the evolution of what is popularly known as the "trust," by which is to be understood a combination of the domestic producers of certain commodities to control production and advance prices. Now while the claim may not be warranted that such combinations are necessarily the result of the protective tariff policy, the experience of the U. S. is absolutely conclusive to the effect that the great majority of trusts existing in that country never would have been formed, and could not continue to exist, were it not for the imposition and continuance of its high protective duties on imports. That this must be so will be manifest if it is called to mind that no trust of the character referred to, operating on articles for which there is a possible competitive supply from other countries, could be maintained in the U. S. for a single month except under one of two conditions. Either all the competitive producers throughout the world must be brought into the trust, or, what is the same thing, the product of the whole world must be controlled; or the product of all foreign producers must be shut out from the markets of this country. The first result is not attainable. It would be obviously impracticable to induce all the manufacturers of starch, for example, in all the different countries of Europe to unite and put the control of their business in hands of trustees residing in the U. S. The *second* is made not only possible, but effective in the highest degree, by the imposition of tariffs, or duties on the importation of the articles in which the trusts are specially interested, so high as to completely bar them out of the U. S. market. These duties the existing tariff act (1893) provides. It thus becomes the creator and preserver of trusts and monopolies, the like of which can not and do not exist under the tariff system of Great Britain, as the starch trust, plate and window glass trust, nail trust, linseed-oil trust, lead trust, cotton-bagging trust, borax trust, ax, saw, and scythe trust, and many others; all of which, freed in a great degree from foreign competition, have advanced prices to American consumers to an extent that will afford them far greater profits than can be fairly considered as legitimate, but in which profits their employees do not participate.

8. It is clear that one of the essential attributes of a just law is that it bears equally upon all subjected to its influence, and that an unjust law must necessarily be also injurious. A system of law imposing protective duties must, in order to be effective, be partial and discriminating, and therefore unequal and unjust; for if a law could be devised which would afford equal protection to all the industrial interests of a nation, it would benefit in fact no interest by leaving everything relatively as before; or, in other words, the attempt to protect everything would result in protecting nothing.

Any system of laws founded on injustice and inequality can not, furthermore, be permanent. The possibility that it can be further changed to meet the further demands of special interests, and the instinctive revolt of human nature against legal wrong and partiality, continually threaten its stability. Hence a system of industry built upon laws establishing protection through discriminating taxes can never have stability of condition; and without such stability there can be no continued industrial prosperity. Apart from these considerations, in a free government, also, where the people enjoy the right to choose and to change their lawmakers at comparatively short intervals, the opinions of the masses will change according to the light they receive; and as their opinion changes, so must necessarily the policy of the government. Tariffs framed to regulate and direct industries can therefore never be permanent under governments that admit the right of the people to vote and to think. Nothing less than a despotism, and an ignorant despotism at that, can maintain a protective tariff at any given standard for any lengthened period. On the other hand, one of the strongest arguments in behalf of freedom of trade is that it makes every branch of industry independent of legislation, and emancipates it from all conditions affecting its stability other than what are natural, and which can in a great degree be anticipated and provided against; and it is undoubtedly from the stability in trade and commerce that a free-trade policy insures that no small part of the commercial and financial supremacy of Great Britain is to be attributed.

9. "A tariff on imports," it is sometimes alleged by the advocates of protection, "obliges a foreigner to pay a part of our taxes." To this it may be replied that if there were any plan or device by which one nation could thus throw off its burden of taxation in any degree upon another nation, it would long ago have been universally found out and recognized, and would have been adopted by all nations to at least the extent of making the burden of taxation thus transferred in all cases reciprocal. If the principle involved in the proposition in question, therefore, could possibly be true, no possible advantage could accrue from its application. But the point itself involves an absurdity. Taxes on imports are paid by the persons who consume them; and these are not foreigners, but residents of the country into which the commodities are imported. A duty on imports may injure foreigners by depriving them of an opportunity of exchanging their products for the products of the country imposing the duty, but no import-taxes will for any length of time compel foreigners to sell their products at a loss, or to accept less than the average rate of profit on their transactions; for no business can permanently maintain itself under such conditions. Where a nation possesses a complete monopoly of an article, as is the case of Peru in respect to guano, and to a great extent (as it has been) with China in the case of tea, the monopoly always obtains the highest practicable price for its commodities, and the persons who find their use indispensable are obliged to pay the prescribed prices. The imposition of a tax on the import of such commodities into a country may compel the monopoly, for the sake of retaining a market, to reduce its prices proportionally; and in such cases the nation imposing the impost may to a degree share the profit of the monopoly. But the price to the consumers is not diminished by reason of the import-duty, and the cases in which any interest has such a complete control over the supply of a product as to enable it to arbitrarily dictate prices are so rare as hardly to render them worthy of serious consideration in an economic argument.

10. Another powerful argument in favor of free trade between nations is that of all agencies it is the one most conducive to the maintenance of international peace and to the prevention of wars. The restriction of commercial intercourse among nations tends to make men strangers to each other, and prevents the formation of that union of material interests which creates and encourages in men a disposition to adjust their differences by peaceful methods rather than by physical force. On the other hand, it requires no argument to prove that free trade in its fullest development tends to make men friends rather than strangers, for the more they exchange commodities and services the more they become acquainted with and assimilated to each other; whereby a feeling of interdependence and mutuality of interest springs up, which, it may be safely assumed, does more to maintain amicable relations between them than all the ships of war that ever were built, or all the armies that ever were organized. Of the truth of this the experience of Great Britain and the U. S. in respect to the "Alabama claims" is a striking example. The moral and religious sentiments of the people of the two countries undoubtedly contributed much to restrain the belligerent feelings that existed previous to the reference of these claims to arbitration; but a stronger restraining element than all, and one underlying and supporting the moral and religious influences, was a feeling among the great body of the people of the two nations that war, as a mere business transaction, "would not pay"; and that the commerce and trade of the U. S. and Great Britain are so interlinked and interwoven that a resort to arms would result in commercial ruin and permanent and incalculable impoverishment to both countries.

11. The question here naturally arises if the above propositions in favor of free trade are correct, and if the doctrine of protection is as false and injurious as it is represented to be, how happens it that free trade does not at once meet with universal acceptance? and how is the adherence of many men of clear intellect and practical experience to the opposite doctrine to be accounted for? One of the best answers to these questions was given by the celebrated French economist Bastiat, in an article written many years ago, entitled *That which is Seen, and That which is Not Seen*, in which he showed that protection is maintained mainly by a view of what the producer gains and a con-

cealment of what the consumer loses; and that if the losses of the million were as patent and palpable as the profits of the few, no nation would tolerate the system for a single day. Protection accumulates upon a single point the good which it effects, while the evil which it inflicts is infused throughout the community as a whole. The first result strikes the eye at once; the latter requires some investigation to become clearly perceptible. The doctrine of protection is also an inheritance of the past, and has all the support which custom, dogma, and prescription can give it. Mankind also divide themselves into two classes—producers and consumers, buyers and sellers. The interest of producers and sellers is that prices shall be high, or that there shall be scarcity; the interest of consumers and buyers is that prices shall be low, or that there shall be abundance. But every person will at once admit that it is for the general interest that there shall be abundance rather than scarcity. But in the case of individuals controlling large agencies for production, their interests as producers and sellers of large quantities of commodities may be made greater than their interests as consumers, if by the aid of legislation the price of what they produce can be raised by discriminating laws, disproportionately over what they consume, or to the cost of production. Men of this class are generally rich beyond the average of the community, and therefore influential in controlling legislation and in determining fiscal policies; and it is but natural that in so doing they should consult their own interests rather than the interests of the masses.

12. It only remains to notice briefly the testimony of history in respect to the influence of free trade as an economic principle upon the development of nations and the progress of civilization.

In the earlier ages in Europe the principle that trade or commerce is mutually advantageous, and that after every fair mercantile transaction both parties are richer than before, was not understood. On the contrary, the generally accepted theory among both nations and individuals in respect to trade was pithily embodied in the old proverb, "What is one man's gain must be another man's loss." Commerce, therefore, it was assumed, could benefit one country only as it injured some other. In accordance, therefore, with this principle, every state in Christendom, in place of rendering trade and commerce free, exerted itself to impose the most harassing restrictions on commercial intercourse, not only as between different countries, but also as between districts of the same country, and even as between man and man. Country was accordingly separated from country and town from town as if seas ran between them. If a man of Liège came to Ghent with his wares, he was obliged first to pay tolls at the city's gates; then when within the city he was encumbered at every step with what were termed "the privileges of companies"; and if the citizen of Ghent desired to trade at Liège, he encountered the same difficulties, which were effectual to prevent either from trading to the best advantage. The revenues of most cities were also in great part derived from the fines and forfeitures of trades, almost all of which were established on the principle that if one trade became too industrious or too clever it would be the ruin of another trade. Every trade was accordingly fenced round with secrets, and the commonest trade was termed, in the language of the indentures of apprentices, "an art or mystery." If one nation saw profit in any one manufacture, all her efforts were at once directed to frustrate the attempts of other nations to engage in the same industry. She must encourage the importation of all the raw materials that entered into its production, and adopt an opposite rule as respected the finished article. At the close of the sixteenth century England undertook the woolen manufacture. By the act of the 8th of Elizabeth the exporter of sheep was for the first offense to forfeit his goods for ever, to suffer a year's imprisonment, and then have his left hand cut off in a market-town on market-day, there to be nailed up to the pillory. For the second offense he should be adjudged a felon and suffer death. At a later period, in the reign of Charles II., it was enacted that no person within 15 miles of the sea must buy wool without the permission of the king; nor could it be loaded in any vehicle, or carried, except between sunrising and sunsetting, within 5 miles of the sea, on pain of forfeiture. It ought to be most instructive to note also that under such restrictions on the trade and commercial movement of wool the price of wool in England exhibited the same phenomena as has followed in latter days similar restrictions in the U. S., namely, continued depression in the price of domestic wool, which in the former country (1576) finally touched a figure less than it had commanded in the time of Edward III.—200 years before. To remedy this state of things, and by creating a better market for wool through a new and enforced use of it, Parliament in 1578 enacted "that every corpse should be buried in a woolen shroud." Gen. Garfield, in a lecture on the *Mercantile System*, which he gave about 1870, after quoting and specially referring to this shroud enactment, added to it the following comment, as full of meaning now as then: "And in such shrouds they were burying, not the bodies of Englishmen alone, but the spirit of English liberty and industry." In 1672 the Lord Chancellor of England announced the necessity of going to war with the Dutch and destroying their commerce, because it was surpassing that of Great Britain; and even as late as 1743 one of the greatest of British statesmen (Somers) declared in the House of Lords that "if our wealth is diminishing, it is time to ruin the commerce of that nation which has driven us from the markets of the Continent by sweeping the seas of their ships and blockading their ports." By the treaty of Utrecht, which concluded the great war of Great Britain and Spain against Louis XIV. and his allies, Great Britain, being able to dictate the terms, secured the adoption of a section by which the citizens of Antwerp were forbidden to use the deep water that flowed close by their walls; and it was further expressly stipulated that the capacious harbor of Dunkirk, in the north of France, should be filled up and for ever ruined, so that French commerce might not become too successful.

There was, however, one notable exception to the all but universal acceptation in Europe during the fifteenth, sixteenth, seventeenth, and eighteenth centuries of the doctrine that the commercial and industrial prosperity of nations was dependent on monopolies and interferences with trade-production and exchanges, and that exception was found in the case of Holland. In a remarkable pamphlet entitled *The True Interest and Political Maxims of the Republic of Holland*, published by Cornelius de Witt, and translated into English in 1746, this great statesman of the Netherlands shows "that the Dutch, though not producing a bushel of wheat, ate the whitest bread in Europe; and though not producing a sheaf of hemp, a single plank, or any iron, had the best fleet which then sailed the sea; because Holland had wealth to pay for these commodities; and possessed this wealth because its trade and all exchanges were left unfettered, unimpeded, unlegislated upon; and that by this free trade the Netherlands became both the most peopled and the richest country on the earth, and loans could be effected there for a lower interest than anywhere else."

With the progress of civilization, and the consequent diffusion of information, the extreme restrictions on trade above noticed, which were formerly so common in Europe, have almost entirely disappeared, and men now wonder that any benefit could ever have been supposed to have accrued from such absurd and monstrous regulations. But the change to a more liberal state of things, though constant, has been slow, and the policy of the Middle Ages, in the process of modification and extinction, gave place to the so-called and more modern policy of "protection," which, while clearly recognizing the impolicy of interfering with domestic exchanges, regards foreign trade as something different from any other trade, which it is for the interest of the state to interfere with and regulate. But under the same influences of a progressive civilization this system too, in like manner, is disappearing.

In this work of progress Great Britain took the lead in 1841; not from a change in popular sentiment due to better acquaintance with theoretical principles, but from a realization on the part of all classes of the people of the results which the recognition and practice of the policy of protection during a period of many years had entailed upon the country. These results Noble, in his work *Fiscal Legislation of Great Britain*, thus describes: "It is utterly impossible," he says, "to convey by mere statistics of our exports any adequate picture of the condition of the nation when Sir Robert Peel took office in 1841. Every interest in the country was alike depressed; in the manufacturing districts mills and workshops were closed and property depreciated in value; in the seaports shipping was laid up useless in the harbor; agricultural laborers were eking out a miserable existence upon starvation wages and parochial relief; the revenue was insufficient to meet the national expenditure; the country was brought to the verge of national and universal bankruptcy." Great Britain, therefore, as it were, under compulsion, and with very grave doubts on the part of many of her ablest financiers and economists, under the lead of Sir Robert Peel abandoned protection as the national policy, and gradually adopted the opposite principle of free trade with all the world. The same author above referred to, writing in 1865, draws the following picture of the results of the change of policy referred to, based on the experience of near a quarter of a century: "It has rendered agriculture prosperous, largely augmented rent, vastly extended manufactures and employment, increased the wages of labor, and, while securing the collection of an increased revenue, has by improving the value of property lessened the burden of taxation. It has been shown, also, that each successive development of this beneficent legislation has extended these results."

In the U. S. the principles of the protective system have since 1860 been reapplied, and are still (1893) maintained, with a degree of rigidity and on a scale of magnitude which have no precedents in recent commercial history. The advocates of the protective policy claim that this policy has been in the highest degree beneficial, and they adduce in support of their claim the continued and remarkable prosperity of the country, its rapid recuperation from the effects of a long war, its increase in population, production, wealth, diversity of products, and marked reduction in cost of many of the great staple articles of popular consumption. That such striking results have been attained can not be questioned; but neither can it be seriously questioned that they are due to the great natural resources of the country, to the energy and intelligence of its people in utilizing them, to the entire absence of all legal restrictions on the movement of persons, or the exchange of their products over an area of territory continental in its proportions, to unrivaled facilities for quick and cheap transportation, a high standard of popular education and free and representative form of government; and that to attribute such results to the adoption and continuance of a national fiscal policy which has for its primary and main objects the imposition of high and unnecessary taxes and the restriction of trade is wholly unwarranted and irrational. An examination of the results of special experiences is also strikingly confirmatory of such conclusions. Thus while the claim is always preferred in the U. S. in behalf of the protective policy that it stimulates manufacturing industries by enlarging the market for their products and emancipating them from foreign competition, the exports of the country continue to be year after year mainly agricultural products, which can not as a rule be protected, while the percentage ratio of the exports of manufactured products to the total exports is comparatively small and increases very slowly, or not at all. Thus for the year 1891 agricultural products—mainly cotton, breadstuffs, animals, provisions, and tobacco—constituted 73·69 per cent. of the total exports of domestic merchandise of the country, and manufactured products only 19·37 per cent., as compared with 19·45 per cent. five years previously, or in 1887. Of manufactures of cotton, for the production of which the U. S. might naturally be supposed to have advantages, the value of the total exports for 1891 was $13,604,000, as compared with $14,105,000 in 1881. Statistics of comparative prices of iron and steel, published in 1888 under the auspices of the American Iron and Steel Association, show that the excess of cost of iron and steel in the ten years from 1878 to 1887 to the consumers of the U. S. by reason of the protective duties imposed on the import of these articles by the latter country was at least $560,000,000, or at an average of $56,000,000 per annum, above that paid in Great Britain during the same period; an aggregate in excess of the entire capital invested in the iron industry of the country, including iron and coal mines and the manufacture of coke, returned by the census in 1880, namely $341,000,000. And all this burden of cost to the people of the U. S., through tariff taxation, in order to sustain a branch of domestic industry which could not have been displaced or destroyed by any possible foreign competition. The inability (as shown by experience) to increase the export of the products of skilled labor has naturally and practically limited the growth of the so-called manufacturing industries of the U. S. to the demand for domestic consumption, and forbidden any enlargement of them consequent upon the increasing ability and desire of other nations to consume, and the increased facilities for effecting international exchanges. As a further legitimate sequence, the commercial marine of the U. S. has been all but annihilated, as is shown by the fact that while in 1860 71 per cent. of the total foreign trade of the U. S. was carried in U. S. bottoms, in 1891 the proportion was only 12·86 per cent. One of the most striking illustrations that could possibly be presented of the evil effect of commercial restrictions in limiting trade and industry, and consequently national development, is to be found in the history of the commercial relations between the U. S. and the British North American provinces. Thus in 1852–53, in the absence of anything like commercial freedom, the aggregate exchanges between the two countries amounted to only $20,691,000. The subsequent year a treaty of reciprocity went into effect, whereby the people of the two countries were enabled to trade and exchange their products with little or no obstruction in the form of import-duties. The result was that the aggregate of exchanges rose the very first year of the operation of the treaty from $20,-691,000 to $33,494,000, which subsequently increased, year by year, until it reached the figure of $55,000,000 in 1862–63, and $84,000,000 in 1865–66. In this latter year the treaty of reciprocity was repealed, and restrictive duties again became operative. The result was that the annual aggregate of exchanges immediately fell to $57,000,000, and in 1881, fourteen full years after the expiration of the treaty, when both nations had largely increased in wealth and population, the decrease of trade consequent on the abrogation of the treaty had not been made good.

It is also curious to note that the people of the U. S. are so well satisfied with the principles of free trade when applied to domestic transactions that, throughout the whole of the broad territory they inhabit, they will not allow the formation or maintenance of the slightest artificial obstruction to the freest exchange of products or to the freest commercial or personal movements, and that, too, notwithstanding the different States and Territories into which the country is divided differ among themselves in respect to wages of labor, prices of commodities, climate, soil, and other natural conditions, as widely as the U. S. as a whole differs from any other foreign country with which it is engaged in extensive commercial intercourse. And it is a striking and anomalous circumstance that a very large number—perhaps a majority—of the people of the U. S. regard trade with foreign nations as something very different from trade among themselves, and as such, therefore, to be subjected to entirely different laws and conditions. But a slight examination ought, it would seem, to satisfy that foreign trade presents no element peculiar to itself, but only the same elements which domestic trade presents, and that, consequently, the same laws and conditions that are applicable to domestic exchanges are equally applicable to foreign exchanges. Men, moreover, do not engage in any trade, foreign or domestic, for mere enjoyment or pleasure, but for the material gain which accrues to both parties. They desist from it also so soon as the mutual advantage ceases. The relation, then, which government ought to sustain to the whole question of exchanges is well expressed in the answer which the merchants of France gave to Colbert more than a century and a half ago, when he asked their advice and opinion "how he could best promote commerce" —*Laissez-nous faire* (Let us alone).

For further information on this subject see Bastiat, *Sophisms of the Protectionists* (American translation); Thompson, *Catechism on the Corn-laws*, London (scarce); Grosvenor, *Does Protection Protect?*; *Reports of the Special Commissioner of the Revenue of the United States*, 1865–70; Prof. W. G. Sumner, *History of Protection in the United States*; David A. Wells, *Our Merchant Marine*; Trumbull, *History of the Free Trade Struggle in England* (published by Iowa State *Leader*); Schoenhof, *The Destructive Influence of the Tariff* (1884); Henry George, *Protection or Free Trade?*; David A. Wells, *Recent Economic Changes*; Rev. N. H. Chamberlain, *What is the Matter? our Tariff and its Taxes* (Boston); Arthur B. and Henry Farquhar, *Economic and Industrial Delusions*. And the following pamphlet publications of the Reform Club of New York: *Comparison, Item by Item, of the Tariff of 1883 and the Tariff of 1890*; David A. Wells, *Relation of the Tariff to Wages*; J. S. Moore, *Friendly Letters to American Farmers and Others*; *United States Tariff History*, a full review, with comparative tables, of the character and effect of all tariffs from the Declaration of Independence to the tariff of 1890, I. A. Lindquist and others. General treatises on political economy by Mill, Macleod, Cairnes, Amasa Walker, Profs. Perry, Simon Newcomb, Bonamy Price, etc., may be read or consulted with advantage. DAVID A. WELLS.

Free Will, or **Freedom of the Will**: a question at once of general philosophical, special psychological, and specific theological import, and so intricate and obscure that diametrically opposite answers have been given and maintained. Freedom, with reference to the will, has been variously defined, the definition as a rule being the result of a theory, not a preliminary to it. The conflict has been in part on the question whether the will is free, one extreme party making it wholly unrelated, separating it even from the control of the agent willing, and another placing it under the rule of an external necessity. (See FATE and NECESSITY.) But more generally it has turned upon the question, What *is* the freedom of the will? Each party here asserts its freedom, but not in the sense claimed by the other. The point of division is this: Does the will decide under the influence of determining motives, or is its ultimate decision an unconditioned, undetermined act? The objection ordinarily made to the first view is that it reduces the will to a necessity which destroys accountability. The objection to the latter view is that it subjects the willing agent to the will, and destroys the possibility of voluntary expression on the part of the agent; he no longer possesses a will, but is possessed by a will. Consciousness is appealed to on both sides: consciousness of freedom and accountability on the one, consciousness of rational and motived choice on the other. See WILL.

For the *psychological* question, see Baldwin, *Handbook of Psychology*, ii., *Feeling and Will*, pp. 280, *seq.*, especially pp. 369, *seq.*, and the literature given on pp. 381–82, especially the following: James, *Principles of Psychology*, ii., xxvi.; Höffding, *Outlines of Psychology*, vii.; Schneider, *Menschliche Wille*, ch. xiii.; Fouillée, *La Liberté et le Déterminisme*; Edwards, *Inquiry into the Will*. Prof. Baldwin states the matter thus: "Freedom is a fact, if by it we mean the expression of one's self as conditioned by past choices and present environment. It is not a fact, in any sense which denies that volition is thus conditioned, first, upon the actual content of consciousness as it swings down the tide of the present life and presses outward for motive expression; and, second, upon the environing circumstances which draw the motive consciousness out" (*l. c.*, p. 373).

In *theology* the question of free will is associated with the doctrines of GRACE, PREDESTINATION, and ORIGINAL SIN (*qq. v.*). In the history of the doctrine the names of Augustine and Pelagius are specially representative. Pelagius, in the interests of conduct, as he thought, taught a doctrine of ability of will which divorced the will from precedent character and, indeed, also from any effect on subsequent character; his doctrine of the will was practically identical with that of the indeterminists or accidentalists. In opposition to him Augustine taught a doctrine of will practically identical with that of the immanent determinists, holding that the will is determined in its activities by the state of the soul, or the character. (See for the contrasted doctrines, Warfield in the prolegomena to Augustine's *Anti-Pelagian Treatises*, in vol. v. of the *Nicene and Post-Nicene Fathers*, published under the editorship of Dr. Schaff.) On these lines theological opinion has ever since been divided into Augustinian and Pelagian or Semi-Pelagian. Prior to the outbreak of this controversy the Greek Church had a leaning to a doctrine similar to what was afterward known as Semi-Pelagianism; the Latin Fathers tended to the views which came into full expression in Augustine. The mediæval theology prevailingly leaned to Semi-Pelagianism. It praised Augustine, but followed Pelagius. In the Reformation both the Lutheran and Calvinistic Churches took strong ground against the entire Pelagian tendency. The theory of SYNERGISM (*q. v.*), given vogue in the Lutheran churches through the influence of Melanchthon, was an attempt at harmonizing the two views. The Arminian doctrine of the will is Semi-Pelagian; and the same general conception has become very influential among the Congregationalists of the U. S., under the "improved" New England theology. Modern German theology is largely synergistic, and its widespread influence is carrying synergistic conceptions into every Protestant land. The following works may be consulted on the theological aspects of the question: Augustine, *Anti-Pelagian Treatises*, E. T., in Schaff's *Nicene and Post-Nicene Fathers*, vol. v.; Anselm, *De Libertate Arbitrii*; Luther, *On the Bondage of the Will*; Edwards, *The Will*; Shedd, *Theological Essays*; H. B. Smith, *Faith and Philosophy*; C. Hodge, *Systematic Theology*, ii., pp. 278–309; Scholten, *Der freie Wille*, on the Augustinian side; and on the opposite side especially Whedon, *The Freedom of the Will*; Luthardt, *Die Lehre des freien Willens*. See also Girardeau, *The Will in its Theological Aspects*.

Revised by B. B. WARFIELD.

Free-will (or **Free**) **Baptists**: a body of Baptist people who reject the tenet of predestination, advocate freedom of the will to refuse or accept Christ, and urge the possibility of salvation to all men through a general atonement. This is the principal point of difference between them and the main body of Baptists, who it is well known adhere to Calvinistic views. (See BAPTISTS.) Another point of difference relates to communion at the Lord's table, the Free-will Baptists advocating open communion, while the others, at least in the U. S., are in the practice of restricted communion.

The Free-will Baptists are not of General but of Separate Baptist extraction. The Separate Baptists were one of the results of Whitefield's activity. Numbers of people in different portions of New England, who belonged to the Standing Order, received the preaching of Whitefield with unusual favor, and preferred his methods above those of the Established Church. Their zeal for religion was carried so far that their former church home shortly became distasteful to them. In many communities there was produced an amount of friction that sooner or later resulted in separation from the Established churches. The new churches thus organized were commonly in sympathy with the doctrines of the Standing Order, but, being no longer in organic union with it, were designated as Separate churches or Separates. The sharp conflicts that arose between the Separates and the Standing Order supplied an opportunity which the Baptists were not slow to embrace; in a few years numbers of the Separate churches accepted Baptist tenets, and henceforth were known as Separate Baptist churches. Possibly three-fourths of all the existing Baptist churches of the U. S. could trace their descent from the Separate Baptist movement. The influence of Whitefield upon the fortunes of Baptists in the U. S. can scarcely be overestimated; it has rarely been estimated as highly as it deserves to be.

The Separate Baptists having been suddenly set loose from their former moorings in the Established Church, it was natural that they should make large use of their new-found freedom. They started the watchword, then first heard among Baptist people, of "No creed except the Bible." Standing upon this broad platform and rejecting all the doctrinal standards hitherto accepted by Baptists, it was to be expected that wide diversity of opinion and practice should be displayed; in fact, it is matter of surprise that the differences were not many times greater than they subsequently proved to be. There were extreme Calvinists, moderate Calvinists, and low Calvinists among the Separate Baptists. Of course it was to be anticipated that now and then some would cross the line entirely and fall into Arminian sentiments. The Free-will Baptists took that course.

Their founder was Benjamin Randall, a man of admirable character, excellent abilities, and apostolic zeal. Born at Portsmouth, N. H., Feb. 7, 1749, he embraced religion in 1770, and was for some years connected with the Standing Order, but joined the Baptists in 1775. A seemingly accidental collision with a minister of decidedly Calvinistic views drove him in 1779 to the opposite extreme, and in 1780 he set about the task of organizing the new Church with great energy and success. New Hampshire and Maine were the scene of his early labors, but churches were soon established in most of the New England States, Canada, and in several of the Middle and Western States.

Apparently no effort was made by the Free-will Baptists to comprehend the General or Arminian Baptists of New England, who had now dwindled from their former glory to a feeble handful under the designation of Six Principle Baptists. On the contrary, the Six Principle Baptists appear to have exercised an important influence upon the development of the Free-will party; the outward organization of the new Church was fashioned after the model that had long prevailed among the Six Principle brethren, there being quarterly meetings, yearly meetings, and possibly other institutions borrowed from that source. In 1827 a correspondence was opened with the original Free-will Baptists of North Carolina, a very interesting and pathetic relic of the period of General Baptist ascendency in the U. S. A union was effected with these, which, however, was destroyed in a few years by the rising tide of opposition to slavery. More or less of intercourse has been cultivated with the much more influential General Baptists of Indiana, Kentucky, and other Western States, who sprang from the ancient community in North Carolina, but as yet no organic union has been accomplished. Also in 1827 the Free-will Baptists were brought into fraternal relations with the English General Baptists of the New Connection, and by this means were soon induced to engage in the work of foreign missions in India. It does not appear that they have ever attempted to form any alliance with the original and more ancient General Baptists of England. When the Separate Baptists in 1787 formed a union with the Regular Baptists it chanced that now and again members of the Separate Baptist fraternity for one or other reason would oppose this consummation. Not a few of these Separate Baptists entered the communion of the Free Baptists, thereby giving them representatives in nearly every Southern State.

The only party with which it has been possible for them to form an organic union are the Free Communion Baptists of New York and other Northern States. Originally this latter party laid emphasis upon open communion, but were moderate Calvinists. The Free-will party rejected Calvinism with decision, but laid no stress upon free communion. Nevertheless in 1821 overtures were made looking toward a union of the two organizations. The enterprise was delayed until 1841, when it was duly accomplished. By this union the Free-will community gained 51 churches and 2,470 members. The two parties have maintained reasonable harmony in the united Church, a circumstance that may be due to the fact that both sides were of Separate Baptist extraction; Benajah Corp, who established the Free Communion Baptists, had been a communicant of a Separate Baptist Church in Rhode Island before his removal to New York. The Free Communion Baptists were sometimes designated as Free Baptists, and since their union with the Free-will brethren that title has often been applied to the entire Church.

Their Church constitution is of the representative pattern, the local churches sending delegates to the quarterly meetings, and these in turn sending delegates to the yearly meetings. In 1827 their ecclesiastical machinery was completed by a general conference, composed of representatives from the yearly meetings. They reported in 1900 1,312 ministers, 1,517 churches, and 85,242 communicants. They are represented in thirty-three States, but are strongest in New England. They have more than 12,000 members in the Southern States. Their schools are numerous and respectable. Bates College, Lewiston, Me., stands at the head of the list, a wealthy and progressive institution, with which is connected the Cobb Divinity School. Hillsdale College, Hillsdale, Mich., and Ridgeville College, Ridgeville, Ind., are institutions of much merit and celebrity.

LITERATURE.—Rev. I. D. Stewart, *History of the Free-will Baptists for Half a Century* (Dover, 1862); Richard Knight, *History of the General or Six Principle Baptists* (Providence, 1827); Porter S. Burbank, *History of the Free-will Baptists* in Winebrenner's *History of All Religious Denominations in the United States* (Harrisburg, 1848). Lives of Randall, Colby, Mack, and other prominent leaders have also been published. WILLIAM H. WHITSITT.

Freezing [deriv. of *freeze* < M. Eng. *fresen*, *freosen* < O. Eng. *freósan* : O. H. Germ. *friosan* > Mod. Germ. *friesen* < Teuton. *friusan*, deriv. of *frius-*, cold (> Goth. *frius*, cold); cf. Sanskr. *pruṣvā*, ice: Lat. *prui'na*, frost]: the change from a liquid to a solid state, resulting from the abstraction of heat. The zero of the centigrade thermometer, equivalent to 32° F., is the freezing-point of water under ordinary conditions. It has been shown by Dr. James Thomson and his brother Lord Kelvin that the increase of pressure upon water, and upon all substances which expand in freezing, will lower the freezing-point. Under a pressure of 13,000 atmospheres water will not freeze at Fahrenheit's zero. On the other hand, such substances as paraffin, which contracts in freezing, have the freezing-point raised by pressure. Artificial freezing can be best induced by the liquefaction of solids or the evaporation of liquids. These processes absorb heat—that is to say, they render it *latent*—and by abstracting it from the surrounding substances freeze the latter. In most cream-freezers the liquefaction of a mixture of pounded ice and salt is the means employed. In artificial ice-making machines the evaporation of ammonia or of the most volatile ethers is the essential element.

ARTIFICIAL FREEZING has been performed, as a mere laboratory experiment, ever since the middle of the seventeenth century. In 1665 Robert Boyle, fellow of the Royal Society, published his success in the repeated freezing of water and other liquids by various chemical mixtures. He attempted mercury, but remarks, "we could not at all freeze this extravagant liquor, though we tried it more than once." Leslie's freezing of water by sulphuric acid in a vacuum in 1810, and Faraday's long-subsequent achievement of solidifying water by sulphurous acid evaporating in a red-hot crucible, are only two of the many well-known varieties of this class of experiments. In what follows reference will be briefly made to four natural principles or methods by which the freezing of water has long been attempted on a considerable scale, and with more or less success for economic purposes.

1. *The Intermixing of Various Chemical Substances.*—Thus a solution of nitrate of ammonia in water depresses temperature 46° F. The nitrate may be recovered by evaporation, and employed again. (For other and considerably more frigorific combinations, see FREEZING-MIXTURES.) They all depend upon producing a solution the specific heat of which is greater than that of the components that enter into the solution. But the superior efficacy of the ordinary mixture of common salt with comminuted ice is mainly due to the consequent liquefying of the ice, by which an absorption of 142·2 British thermal units per pound is necessary for the latent heat of liquefaction.

2. By far a more powerful and a more manageable principle is the absorption of heat into vapor expanding and escaping from a volatile liquid. The vapor of water is supereminent in requiring 966 B. T. U. per pound for the latent heat at atmospheric pressure, while ammoniacal vapor requires 596 B. T. U., and sulphuric ether about 164 B. T. U. Yet another facility afforded by the more highly volatile liquids is the low temperature at which volatilization or ebullition takes place under the ordinary atmospheric pressure. Thus sulphuric ether boils at 95° F. (35° C.). Faraday published in 1825 his observation that certain of the hydrocarbons boil at or near the freezing-point of water. Pure ammonia boils at — 36° F. (— 38·5° C.).

3. The re-expansion of compressed air, as well as of other gases, is powerfully refrigerative. The heat developed by compression is first to be absorbed by cold water. Then the re-expansion against pressure produces cooling in the gas sufficient, if abstracted from its own weight of water, to depress the latter in temperature at the rate of one degree for each unit of energy expended in expansion, or for the amount of work necessary to raise the same weight 778 feet against gravity.

4. A frigorific agency, not dependent like the foregoing upon either mechanical force or chemical reactions, is afforded, under favoring circumstances, by radiation into the cosmical spaces. Robert Boyle quotes from "the diligent Olearius," more than two centuries ago, a statement that ice was ordinarily produced in the hot climate of Ispahan, the capital of Persia, in layers a finger thick, by pouring water at successive intervals in the night "upon a shelving pavement of freestone or marble." It has, moreover, long been known that in Bengal and other provinces in India ice is obtained for domestic use by exposing at night shallow earthen vessels resting upon a flooring of dry stalks and leaves in pits 2 feet deep. It has been said that a similar practice exists in Eastern China. In these instances merchantable cakes are produced by superimposing the thin layers one upon another, to unite by simple regelation. This method has been attempted both in Great Britain and in France with success as a mere experiment, but not to the extent of economic value. It is a study for philosophers to explain how it could succeed, even as an experiment, in a warm or temperate atmosphere.

To the utilization of chemical affinities for frigorific purposes the only requisites are a simple commixture or solution of the substances employed, and a flow of the cold mixtures upon or along metallic sheets or surfaces containing the substances to be cooled. Non-conductors of heat are employed for protection externally against radiation and the atmospheric warmth. In the employment of volatile liquids the evaporation is effected by drawing off or exhausting the vapor from the cooling vessel as fast as it is formed, either by a gas-pump or by the affinity of a liquid or other substance which will absorb the vapor with great avidity. Such, for example, is the affinity of water or of chloride of silver for ammoniacal gas, or of sulphuric acid or anhydrous chloride of calcium for watery vapor. Another mode of disposing of the vapor might be, in certain instances, to condense it upon a cold surface present in the evaporating vessel or in communication with it. A familiar illustration of this last expedient is the philosophical apparatus known as the "cryophorus"; another is the common laboratory paradox of making water boil in a flask by affusion of cold water on the outside. See the articles FREEZING-MIXTURES, GAS, ICE, ICE-MAKING, and REFRIGERATING PROCESSES. Revised by R. H. THURSTON.

Freezing-mixtures: combinations of substances whose fusion or interaction causes a reduction of temperature. When solids are liquefied (fused or dissolved) they absorb a certain quantity of heat, which is thus rendered latent—is no longer indicated by the thermometer. This heat is called *latent heat of fusion* or *fluidity*. If we mix equal weights of water at 0° C. (32° F.) and water at 79° C. (172·4° F.), the temperature of the mixture will be the mean of the two temperatures, or 39·5° C. (103·1° F.). But if we repeat the experiment with snow or pounded ice at 0° C. and water at 79° C., the temperature of the whole will be only 0°, *but the ice will have been melted*. A quantity of heat, represented by 79° C. (174·2° F.), will have been apparently lost in melting the ice. If we place in a warm room two vessels, one containing a kilogramme of water at 0° C., the other a kilogramme of snow at 0° C., we shall find when the snow is melted that its temperature is only 0°, while the temperature of the water in the other vessel has risen to 79° C. (174·2° F.). This principle is true of all solids: they absorb in melting a certain quantity of heat, without indicating by the thermometer any increase in temperature. The following table exhibits the latent heats of fluidity of a few solids, expressed in heat-units:

LATENT HEAT ABSORBED BY ONE KILOGRAMME IN MELTING.

Ice	79	units.
Sulphur	80·5	"
Spermaceti	82·22	"
Lead	90	"
Beeswax	97·22	"
Zinc	274	"
Tin	277·77	"
Bismuth	305·55	"

The solution of most salts in water is attended with absorption of heat as the salt is liquefied. The following table contains a few illustrations of this principle:

MIXTURES.		Thermometer sinks—	Cold produced.
Nitrate of ammonia Water	1 part 1 "	From +50° F. to + 4° F. " +10° C. to −15·55° C.	46° F. 25·55° C.
Chloride of ammonium Nitrate of potassa Water	5 parts 5 " 16 "	From +50° F. to +10° F. " +10° C. to −12·22° C.	40° F. 22·22° C.
Chloride of ammonium Nitrate of potassa Sulphate of soda Water	5 parts 5 " 8 " 16 "	From +50° F. to + 4° F. " +10° C. to −15·55° C.	46° F. 25·55° C.
Nitrate of ammonia Carbonate of soda Water	1 part 1 " 1 "	From +50° F. to − 7° F. " +10° C. to −21·67° C.	57° F. 31·74° C.

The most remarkable salt in this respect is the sulphocyanide of ammonium. Phipson (*Chem. News*, xviii., 109) states that on dissolving this salt in an equal weight of hot water at 96° C. (204·8° F.) he was surprised to see the outside of the vessel covered with hoar-frost, and on introducing a thermometer into the solution he found its temperature to be two to three degrees centigrade below zero (28·4°–26·6° F.); ninety-eight to ninety-nine degrees centigrade of heat (176·4°–178·2° F.) had been required to liquefy the salt. By employing acids instead of water still greater reduction of temperature results:

MIXTURES.		Thermometer sinks—	Cold produced.
Sulphate of soda Nitric acid, dilute	3 parts 2 "	From +50° F. to − 3° " +10° C. to −19·44°	53° F. 29·44° C.
Phosphate of soda Nitric acid, dilute	9 parts 4 "	From +50° F. to −12° " +10° C. to −24·44°	62° F. 34·44° C.
Sulphate of soda Hydrochloric acid	8 parts 5 "	From +50° F. to − 0° " +10° C. to −17·78°	50° F. 27·77° C.
Sulphate of soda Sulphuric acid, dilute	5 parts 4 "	From +50° F. to + 3° " +10° C. to −16·11°	47° F. 26·11° C.
Sulphate of soda Nitrate of ammonia Nitric acid, dilute	6 parts 5 " 4 "	From +50° F. to −14° " +10° C. to −25·55°	64° F. 35·55° C.

In a suitable apparatus a mixture of 6 parts sulphate of soda (Glauber's salt) and 5 parts hydrochloric acid will freeze 5 parts of water. The best results are obtained when considerable quantities are employed. The lowest temperatures are produced by mixing snow or pounded ice with the salt employed. The salt causes the snow to melt, with the absorption of its heat of fusion, and the water produced dissolves at the same time the salt, which in turn absorbs its latent heat. Such mixtures are used for freezing ice-cream and water-ices, champagne, etc., and for condensing very volatile vapors. The temperature of ice-cream is often 15° F. or lower; 2 parts of pounded ice and 1 of salt are used for ice-cream; 3 parts of crystallized chloride of calcium (cooled to 0° C. = 32° F.) and 2 of snow will freeze mercury, producing a temperature of − 45° C. = − 49° F.

The following are mixtures which may be used for freezing:

MIXTURES.		Thermometer sinks—	Cold produced.
Snow or pounded ice Common salt	2 parts 1 "	To − 5° F. " −20·55° C.	
Snow or pounded ice Common salt Sal-ammoniac	5 parts 2 " 1 "	To −12° F. " −24·44° C.	
Snow or pounded ice Common salt Sal-ammoniac Niter	24 parts 10 " 5 " 5 "	To −18° F. " −27·78° C.	
Snow or pounded ice Common salt Nitrate of ammonia	12 parts 5 " 5 "	To −25° F. " −31·67° C.	
Snow Sulphuric acid, dilute	3 parts 2 "	From +32° F. to −23° " + 0° C. to −30·55°	55° F. 30·55° C.
Snow Hydrochloric acid	8 parts 5 "	From +32° F. to −27° " + 0° C. to −32·78°	59° F. 32·77° C.
Snow Nitric acid, dilute	7 parts 4 "	From +33° F. to −30° " + 0° C. to −34·44°	62° F. 34·44° C.
Snow Chloride of calcium, cryst	2 parts 3 "	From +32° F. to −50° " + 0° C. to −45·5°	82° F. 45·55° C.
Snow Potash	3 parts 4 "	From +32° F. to −51° " + 0° C. to −46·1°	83° F. 46·11° C.

For further information on this subject, see ICE, ICE-MAKING, and REFRIGERATING PROCESSES, and consult Cooke's *Chem. Physics*; Ganot's *Physics*; Ure's *Dictionary*, Freezing; and Watt's *Dictionary*, Heat.

Fregel'læ: an ancient Volscian town, colonized by Rome in 328 B. C. It stood on the right bank of the Liris, probably nearly opposite Ceprano, and commanded the passage of the river. It was large, opulent, and faithfully devoted to the interests of Rome, but in 125 B. C. it was utterly destroyed by L. Opimius, in consequence of an insurrection. Its ruins doubtless afforded materials for building Fabrateria and other towns near by.

Freiberg, frī'bărch: town of Saxony (founded in 1175); on railway, at the foot of the Erzgebirge; 20 miles S. W. of Dresden (see map of German Empire, ref. 5–G). It is situated in one of the richest mining-regions of Europe, no less than 1,500 mines of silver, copper, and lead being worked in the neighborhood, and is the center of administration for the Saxon mines. Its mining school, having thirteen professors, a library of 18,000 volumes, a most excellent collection of minerals bequeathed to it by Werner, is a very celebrated institution, and visited by students from all European countries. The town has some manufactures of machinery, gold and silver ware, and leather, and an excellent system of water-works. Pop. (1895) 29,282.

Freiburg, frī'boor*k*h: town of the grand duchy of Baden, Germany; on the western slope of the Black Forest; 35 miles S. of Strassburg (see map of German Empire, ref. 7–D). Its cathedral, commenced in 1122 and finished in 1514, with a tower 367 feet high, is one of the finest specimens of Gothic architecture in Germany. Freiburg is the seat of an archbishopric and has a well-frequented university, founded in 1455, and manufactures of sewing silk, beads, buttons, paper, etc. Freiburg was founded in 1091, became a town in 1115, and after changing masters several times finally fell to Baden in 1806. Pop. (1895) 53,109.

Freiburg: canton of Switzerland, between Berne, Vaud, and the Lake of Neuchâtel; area, 644 sq. miles. The southern part is mountainous, though none of the peaks reach the snow-line; the northern part is more level. The whole canton abounds in excellent pastures, and although it has some manufactures of straw-plait, leather, and tobacco, cattle-breeding and dairy husbandry are the main business of the inhabitants. The cheese from this canton is said to be the best produced in Switzerland. Eighty-four per cent. of the inhabitants are Roman Catholics, and more than three-fourths are of French descent and speak French, which is the official language. Pop. (1888) 119,529; (1894) 122,058.

Freiburg: a quaint but picturesque old town of Switzerland; capital of the canton of Freiburg; on the Saane, over which is built a suspension bridge 906 feet long, 28 feet wide, and 175 feet above the water (see map of Switzerland, ref. 5–D). Its cathedral is a fine building, with a famous organ having 7,800 pipes. It is the seat of a Roman Catholic university and a bishopric. Pop. (1888) 12,244.

Freight [Late M. Eng. *freight*, *freyt*, due to influence of two words, both originally from the same source, (1) M. Eng. *fraught* (> Eng. *fraught*, freight), from Dutch *vracht* (whence Germ. *Fracht*): O. H. Germ. *frēht*, gain, reward); (2) Fr. *fret*, freight, from O. H. Germ. *frēht*]: (1) goods or cargoes transported from one place to another by carriers; (2) the price to be paid for such transportation. The term is also used sometimes to denote the compensation paid for any use of vessels, including the carriage of passengers. Only the second meaning of the term will be here considered. The nature of the obligation to pay freight, its amount, and the time of payment may be varied to a great extent by the stipulations in the contract of affreightment, evidenced by the charter-party or the bill of lading. Thus the shipper of goods may hire the entire capacity of a vessel or some specific portion for a gross sum agreed upon or at certain rate per ton, and he will then be bound to pay for the entire space engaged, even though it be not used, the amount paid for the space not occupied being termed "dead freight." Or the agreement may be to pay only according to the quantity of goods actually shipped, and the sum due might then be varied at the option of the shipper. If no definite stipulations were made in regard to the freight, a contract for its payment would still be implied by law, and its amount would be determined by the usage of trade and the circumstances of the particular case. The general principles governing the contract of affreightment, and not often modified by particular agreement, are—that the shipowner after receiving a cargo on board has a right to retain it until the completion of the entire voyage of transportation; that his right to claim freight does not exist until the final destination is reached; and that he has then a lien upon the goods for the satisfaction of his proper charges. A partial completion of the voyage only will not give the shipowner or master a right to insist upon the payment of any freight whatever. The consigner may demand an entire fulfillment of the contract and delivery of the cargo at its destination, and if compliance be refused he may retake his goods and is discharged from all obligation. The lien of the carrier differs from most liens of a maritime nature, in that it depends upon the possession of the goods, and if delivery be made he has only a personal claim against the consignee or consigner. But if there is only a partial delivery of the cargo, the lien on the remainder is not destroyed, but subsists as a security for the entire claim. A carrier's lien is generally enforced in a court of admiralty. The amount of freight-money payable is sometimes diminished by the arrival of the goods at their destination in a deteriorated condition or diminished in quantity. If the injury is occasioned by the negligent stowage or packing of the cargo, or by any default on the part of the master, the damages sustained may be deducted from the freight. But if the deterioration occurred by reason of natural causes, and could not have been prevented by reasonable care, as if the loss should be occasioned by natural waste, decay, or evaporation, or by unavoidable perils of the sea, the carrier is not answerable for the accident, and no diminution from the entire freight is allowed. If articles arrive in substantially the same form as when shipped, even though there may have been a change in their quality affecting their value, it is a general rule that full freight has been earned. Under no circumstances can a cargo which has arrived be abandoned to the shipmaster because its value has been so much diminished as to be less than the sum demanded for transportation. If the carrier is responsible for the loss, a counterclaim may be set up against him to neutralize his demand, or, as in Great Britain, a separate action may be instituted. If the carrier is not in fault, the goods must be received and the entire freight liquidated.

An apportionment of freight sometimes results as the consequence of a disaster upon the voyage, by which a vessel is compelled to put in at an intermediate port for repairs. The carrier has a right in such cases to retain the goods if he desires, complete his repairs with reasonable expedition, and proceed to his destination, or he may send them forward by some other vessel and thus earn full freight. In such a case the carrier may demand freight for the entire voyage, if the owner refuses to allow him to take or forward the goods to their destination. If the carrier refuses to so take or forward them he is entitled to no compensation. If he delivers the goods to the owner at the owner's request, he may claim a *pro rata* freight.

It is a general principle of the marine law that the earning of freight is a necessary prerequisite to the payment of the seaman's wages, or, as the terse legal maxim expresses it, "freight is the mother of wages." The reason of this rule is based upon the policy of stimulating the sailors to a careful performance of their duties and to the exertion of every effort to prevent disaster to ship or cargo, that the voyage may be successfully completed. But the application of the rule is not extended further than this reason for its adoption would justify. For if the loss of freight be attributable to the wrongful act of the shipmaster or the owner of the cargo, it would be grossly unjust to deprive the seamen of their just compensation; and though the vessel should be wrecked and abandonment become necessary, yet if the sailors used all practicable measures to insure her safety and reach port, their claims for wages would be enforced. The rule that wages shall depend upon the earning of freight has been abolished in Great Britain by statute, but the same result is practically obtained by the provision that a failure on the part of a seaman to exert himself to the utmost to save the ship and cargo shall defeat his claim. In the U. S. the common-law doctrine has not been altered. See SHIPPING. T. W. DWIGHT.

Freiligrath, frī'lich-raat, FERDINAND: poet; b. at Detmold, Germany, June 17, 1810; entered upon a mercantile life, performing also literary work which attracted much attention. His first volume of poems (*Gedichte*, 1838; 20th ed. 1862; 31st, 1874) won him a pension, which he renounced in his *Glaubensbekenntniss* (1844), a work so full of republicanism that he was prosecuted, and fled to London. He returned and took part in the revolution of 1848; was imprisoned and tried for the political opinions expressed in his poems, and, though acquitted (in the first jury-trial ever held in Prussia), was compelled to leave the country; returned to London 1851, and in 1868 removed to Stuttgart. Among his works are *Ça Ira* (1846); *Die Revolution* (1848); *Neuere politische Gedichte* (1849), a masterly translation of Victor Hugo's poems; translations of Burns, of Longfellow's *Hiawatha*, and many English poems. His more recent songs, such as *Hurrah, Germania*, and *Die Trompete von Gravelotte*, are, like all his works, highly popular. D. Mar. 18, 1876.

Freind, frend, JOHN, M. A., M. D., F. R. S.: physician; b. at Croton, North Hants, England, 1675; was trained at Christ Church, Oxford, where he became lecturer on Chemistry in 1704; attained great distinction as a physician of London; now chiefly remembered for his valuable *History of Physic* (1725–26). D. July 26, 1728.—His brother, ROBERT FREIND, D. D. (1667–1751), was a celebrated Latin scholar; and WILLIAM FREIND, D. D., Robert's son, was a dean of Canterbury and a prominent preacher.

Freinsheim, frīns'hīm, JOHANN (*Freinshemius*): classical commentator; b. at Ulm, Nov. 16, 1608; studied at Marburg and Giessen; went to Strassburg, where he found a patron in Bernegger, rector of the college; published an edition of Florus, with useful notes, in 1632; was made Professor of Eloquence in the University of Upsala, and after five years' service (1647) became librarian and historiographer to Queen Christina. Compelled by ill-health to leave Sweden, he was appointed in 1656 honorary professor at Heidelberg, where he died Aug. 31, 1660. His labors were devoted mainly to the elucidation of the Latin historians. Besides Florus, he edited Quintus Curtius (Strassburg, 1640, 2 vols. 8vo), in which the missing books were supplied by himself; he supplied also in a continuous narrative, from scattered hints in other writers, the missing books of Livy, first published together by Doujat in the Delphin edition (1679–82). These justly celebrated *Supplements* have been reprinted in some of the later editions of this author; for instance in Drakenborch's *Livy* (17 vols., 1820). Revised by ALFRED GUDEMAN.

Freire, Ramon: general and politician; b. in Santiago, Chili, Nov. 29, 1787. He joined the patriot army in 1811; after the defeats of 1814 fled to Buenos Ayres; was engaged with Brown in a naval expedition, and in 1816 and 1817 served under San Martin in the recovery of Chili. Later he held independent commands in the south, and on Nov. 27, 1820, defeated Vicente Benevides at Concepcion. As chief of the liberal party he opposed the dictatorship of O'Higgins, and on the deposition of that leader was elected supreme director, or virtually dictator (1823). Early in 1826 he drove the Spaniards from Chiloé, thus putting an end to their rule in Chili. Re-elected supreme director in 1827, he resigned soon after. In 1830 he headed an insurrection against the conservatives, who had come into power. After several months' fighting he was defeated at the battle of Lircai (Apr. 17, 1831), captured, and banished to Peru. In 1836 he made an unsuccessful descent on Chiloé. He was allowed to return in 1842, and thereafter lived in retirement until his death at Santiago, Dec. 9, 1851. Herbert H. Smith.

Freire de Andrada, Gomes: administrator; grandfather of Ramon Freire; b. in Coimbra, Portugal, 1684. After important military services in Portugal, he was appointed (May 8, 1733) governor and captain-general of Rio de Janeiro, and interim governor of São Paulo and Minas. As then constituted these captaincies embraced all Southern Brazil, and for a time the new captaincies of Goyaz and Cuyabá were added to his government, comprehending Central and Western Brazil. The administration of Gomes Freire lasted nearly thirty years, being the longest and most prosperous in the colonial history of the country. Colonization was pushed southward to Santa Catharina; the rich gold mines of the interior attained their greatest development; and the first attempts were made to establish a definite boundary between the Portuguese and Spanish possessions in America. Gomes Freire was created Count of Bobadilla, Oct. 8, 1758. D. at Rio de Janeiro, Jan. 3, 1763.

Herbert H. Smith.

Fréjus, frā'zhüs' [Fr. < Lat. *Forum Julii*, liter., the market-place of Julius]: an ancient town of France; department of Var; on the Mediterranean, and on the railway to Nice; 45 miles N. E. of Toulon (see map of France, ref. 9-I). It is a bishop's see, and has some Roman remains. Its harbor, once a Roman naval station of importance, is almost entirely filled by silt from the river Argens. Here Napoleon I. took ship for Elba Apr. 27, 1814. Pop. (1896) 3,510.

Fréjus, Col de: a depression in the crest of the Cottian Alps, lying about 16 miles S. W. from the summit of the Mont Cenis pass, and rising to the height of about 9,500 feet above the sea. Here a tunnel was excavated by the governments of Italy and France between the years 1857 and 1871. For a long time this great work has been known as the Mont Cenis tunnel, but its proper designation is the tunnel of the Col de Fréjus, or Mont Fréjus. See Tunnels and Tunneling.

Frelinghuysen, free'ling-hī-zen, Frederick: soldier and politician; b. in Somerset co., N. J., Apr. 13, 1753; graduated at Princeton 1770; was in Congress in 1775, in 1778-79, and in 1782-83; served with much distinction in the Revolutionary war, rising from the grade of captain to that of colonel; and after the war served as major-general on the Western frontier against the Indians; was a U. S. Senator from New Jersey 1793-96; was an able lawyer, and held various public offices. D. Apr. 13, 1804.

Frelinghuysen, Frederick Theodore: lawyer; b. at Millstone, N. J., Aug. 4, 1817; a nephew of Theodore Frelinghuysen, who adopted him as a son; graduated at Rutgers College 1836; was called to the bar in 1839; was appointed attorney-general of New Jersey 1861 and 1866; U. S. Senator 1866-69, and re-elected in 1871 for the full term. He took a prominent position in the Republican party in the proceedings to impeach President Johnson, and was chosen to reply to the last annual message sent by the latter to Congress. In July, 1870, President Grant appointed him minister to England, but he declined the position. After the close of his senatorial term he took comparatively little part in public affairs until he was appointed Secretary of State, Dec. 12. 1881, by President Arthur. D. in Newark, N. J., May 20, 1885.

Frelinghuysen, Theodore, LL. D.: son of Gen. Frederick Frelinghuysen; b. at Millstone, N. J., Mar. 28, 1787; graduated at Princeton 1804; was admitted to the bar 1808; was a captain of volunteers 1812-15; was attorney-general of New Jersey 1817-29; U. S. Senator 1829-35; mayor of Newark 1837 and 1838: removed to New York 1838; chancellor of the University of New York 1839-50; president of Rutgers College, New Brunswick, N. J., from 1850 till his death, in New Brunswick, Apr. 12, 1861. In 1844 Mr. Frelinghuysen was Whig candidate for Vice-President on the Clay ticket. In public life his acts were ever regulated by exalted moral and religious principles. He favored all measures which might tend to alleviate human misery or misfortune, and was a leader in many charitable and religious enterprises; was for years president of the American Tract, Temperance, and Bible societies and the American Board and other missionary societies. His qualities as a lawyer and statesman were of a high order. See his biography by T. W. Chambers (New York, 1863).

Frelinghuysen, Theodorus Jacobus: b. at Lingen, West Friesland (now in Prussia), about 1691; was ordained to the Reformed ministry in 1717, and was pastor at Embden, Holland, till 1719; went in 1720 to America, and became the Dutch pastor at Raritan (now New Brunswick), N. J., and preached in that region with great zeal and success till his death, probably in 1747. His five sons, Theodore, John, Jacobus, Ferdinandus, and Henricus, were all ministers of the Reformed Church.

Frémiet, frā'mi-ā', Emmanuel: sculptor; b. in Paris in 1824; received his first art instruction in the studio of his uncle, François Rude; was for many years connected with the medical school as anatomical draughtsman; made his *début* in the Salon of 1843 with his *Gazelle*, a figure in plaster-of-Paris, and was in 1875 appointed Professor of Drawing in the Museum of Natural History. Among the most celebrated of his works are *Le Chien courant blessé*, in the Museum of Luxembourg, 1849; *Le Cheval à Montfaucon*, bought by the state, 1853; an equestrian statue of *Napoleon I.*, erected at Grenoble; an equestrian statue of *Louis Duke of Orleans*, in the courtyard of the Castle of Pierrefonds (*q. v.*); an equestrian statue of *Jeanne d'Arc* at Paris, in the Place des Pyrenées; the colossal elephant which decorates one of the four corners of the fountain at the Trocadéro, in Paris; an equestrian statue of the great *Prince of Condé*; a *Mounted Torch-bearer of the Fifteenth Century*; a bronze statue in the Paris Hôtel de Ville; a *She Bear Defending its Young from a Man of the Stone Age*, exhibited in 1885. He is an officer of the Legion of Honor since 1878.

Fremont': village; Newaygo co., Mich. (for location of county, see map of Michigan, ref. 6-H); on Ch. and West M. Ry.; 10 miles N. E. of Newaygo; in a fertile agricultural region. It has a foundry, a tannery, a furniture-factory, and water-works. Fremont Lake, just S. of the town, is a pleasant summer resort. Pop. (1880) 902; (1890) 1,097; (1900) 1,331.

Fremont: city and railway junction; capital of Dodge co., Neb. (for location of county, see map of Nebraska, ref. 10-G): situated near Platte river, 47 miles N. W. of Omaha. It has numerous churches and schools, a normal and business college, stockyards, pork-packing houses, a manufactory of creamery supplies, machine-shops, creamery, harness-factory, flouring-mills, planing-mills, water-works, sewers, gas and electric lights, street railways, and a telephone system. It is a great market for horses, cattle, hogs, and sheep. Pop. (1880) 3,013; (1890) 6,747; (1900) 7,241.

Editor of "Herald."

Fremont: city and railway center; capital of Sandusky co., O. (for location of county, see map of Ohio, ref. 2-E); situated on Sandusky river, 30 miles E. of Toledo. It has excellent schools and manufactures of carbons, engines, boilers, shears, cutlery, spikes, sash, doors, blinds, tubs, staves and barrels, etc. It has also several gas-wells, and is the center of the Gibsonburg oil and gas field. Sardis Birchard, foster-father of President Hayes, gave two valuable tracts of land to the city for parks, and presented $50,000 for a public library. The city has purchased the Fort Stephenson property, the scene of Croghan's victory, for a public park. Pop. (1880) 8,446; (1890) 7,141; (1900) 8,439.

Editor of "News."

Frémont', John Charles: soldier and politician; b. in Savannah, Ga., Jan. 21, 1813. His father was a French immigrant. He received a good education, though left an orphan when four years old, and when seventeen years old graduated at Charleston College, South Carolina; taught mathematics; turned his attention to engineering, and was recommended to the Government to be employed in the Mississippi survey. He afterward served at Washington in constructing maps of that region. Having received the commission of a lieutenant of engineers July 7, 1838, he proposed to the War Department to penetrate the Rocky Mountain region. His plan was approved, and in 1842 he explored the South Pass. Soon after he planned a new expedition to Oregon. He approached the mountains by a new route, examined the region S. of the South Pass, turned aside to the Great Salt Lake, and connected his exploration with that of Wilkes's expedition. Frémont conducted another party, which discovered new and grand features in Alta California, the great basin called by his name, the Sierra Nevada, the San Joaquin and Sacramento valleys, and determined much of the geography of the far Western regions. In 1845 he was again on the road to the Pacific to examine in detail the Pacific slope—a journey which resulted in giving many new facts of importance to the world, and indeed gave California to the U. S. It was rumored not only that the Mexicans were negotiating with Great Britain for the sale of California, but also that the Mexican governor, Gen. de Castro, intended to destroy the settlements on the Sacramento river; and when Frémont reached California, he actually found De Castro on the march against the settlements. The settlers flew to arms and joined Frémont's camp. On June 15, 1846, he captured a Mexican post at Sonoma Pass, with 9 cannons and 250 muskets; and on July 5 De Castro and his force were completely routed. The settlers declared themselves independent, and elected Frémont governor of the province. He immediately proceeded to join the U. S. naval forces at Monterey, under Commodore Stockton, who had lately arrived with authority from Washington to conquer California. After the conquest of Upper California, in which he thus bore a conspicuous part, he was involved in a quarrel between two other officers, and was deprived of his commission by sentence of a court martial. The President offered to reinstate him, but he declined. He retrieved his honor by the survey of a route for a great road from the Mississippi to San Francisco; pierced the hitherto unknown country of the Apaches; defeated or terrified the hostile savages; and in 100 days after leaving Santa Fé reached the Sacramento; was sent as one of the first U. S. Senators from California, serving 1849–51. He was in 1856 the first Republican candidate for President, in opposition to Mr. Buchanan, the Democratic candidate, and though he received a large vote (114 electoral votes to 174 for Buchanan and 8 for Fillmore) he was defeated. Appointed major-general of volunteers May 14, 1861, he served in Missouri and in the Shenandoah valley. Resigned June 4, 1864. Major-general retired Apr. 28, 1890, by act of Apr. 19, 1890. D. July 13, 1890. See *Memoirs of my Life* (1886).

Frémont, frā'mōṅ', JULES JOSEPH TASCHEREAU, D. C. L.: legal writer; b. in Quebec, Canada, Dec. 20, 1855; and educated at St. Mary's College, Montreal, and Laval University. He was admitted to the bar in 1878, and elected to the Dominion Parliament in 1891. In 1893 he was Professor of Civil Law in Laval University, and mayor of the city of Quebec. He is author of *Le Divorce et la Séparation de Corps* and *Compendium of the Dominion Laws of Canada*. NEIL MACDONALD.

Frémy, frā'mee', EDMOND: chemist; b. in Versailles, France, Feb. 28, 1814; professor in the Museum of Natural History, Paris, and at the École Polytechnique. Author of *Traité de Chimie* and *Encyclopédie Chimique* (10 vols., 1881 ff.). D. in Paris, Feb. 3, 1894.

French, DANIEL CHESTER: See the Appendix.

French, GEORGE FRANKLIN: See the Appendix.

French, JOHN: physician; b. about 1616 at Broughton, near Oxford, England; educated at Oxford, studied medicine, and served in the Parliamentary army. D. in Boulogne in 1657. He published a *Treatise of the Choicest Spagyrical Preparations, Experiments, and Curiosities Performed by Way of Distillation* (1651), and *The Yorkshire Spaw; or, A Treatise of Four Famous Medicinal Wells* (1652).

French, JOHN RAYMOND: See the Appendix.

French, JOHN WILLIAM, D. D.: clergyman, author, and teacher; b. at New Haven, Conn., Nov. 9, 1809; graduated at Trinity College, Hartford, Conn., 1832; and subsequently studied at the Episcopal Seminary, New York. Ordained in 1835 and became Professor of Rhetoric and librarian at Bristol College, Pennsylvania, 1836, but the institution failing, he was rector of St. Paul's church, Portland, Me., 1836–39; chaplain to Congress 1841; rector of the Church of the Epiphany, Washington, D. C., 1842–56; Professor of Ethics, U. S. Military Academy at West Point, N. Y., 1856–71; and died there July 8, 1871. Author of a text-book of *Practical Ethics* (New York, 1864) and an admirable work on English grammar (1863). JAMES MERCUR.

French, NICHOLAS: bishop; b. at Wexford, Ireland, in 1604; d. in Ghent, Aug. 23, 1678. He studied and took holy orders at Louvain; became a Roman Catholic priest in his native town, and was appointed Bishop of Ferns in 1646. Having taken a very active part in the political disturbances of his time, he retired to the Continent in 1651 and was about 1670 appointed coadjutor-archbishop of Ghent. His *Unkind Deserter, Bleeding Iphigenia, Sale and Settlement of Ireland*, and other polemical and political pamphlets, were published in London (1846) under the title of *Historical Works of Bishop French* (2 vols.).

French, WILLIAM HENRY: soldier; b. at Baltimore, Md., Jan. 13, 1815; graduated at West Point July 1, 1837; entered the army as second lieutenant of artillery; served in the Seminole war, and on the Canada border during the disturbances 1837–38. During the war with Mexico he served at the siege of Vera Cruz, the battles of Contreras and Churubusco, and the capture of Mexico; served against the Seminoles 1850–52, and on garrison and frontier duty till 1861. Appointed a brigadier-general in Sept., 1861, and major-general in Nov., 1862, he fought at Yorktown, the battles of Fair Oaks, Gaines's Mill, Peach Orchard, Savage Station, Malvern Hill, Antietam, Fredericksburg, and Chancellorsville. In May, 1864, he was mustered out of the volunteer service. From 1865 to 1872 he was in command of the Second Artillery. He passed through the successive grades to that of colonel, and retired at his own request July 1, 1880. D. May 20, 1881.

French Berries: the name given by dyers to the dried berries of various species of *Rhamnus* or buckthorn, which are brought from the Mediterranean countries, and produce a very bright but not very permanent yellow dye. The yellow-berried buckthorn is a very spreading procumbent shrub, growing wild in rough rocky places in the countries near the Mediterranean. The berries are also called Persian and Avignon berries.

French Broad River: a river of the U. S.; rises in Henderson co., N. C., near the Blue Ridge, flows N. W. into Tennessee, receives the Nolichucky, turns S. W., and joins the Holston (now called Tennessee) 3 miles above Knoxville. There is delightful scenery along its banks. It is navigable 30 miles to Danbridge by steamboats, and is some 200 miles in length.

French Congo: See GABOON-CONGO.

French Horn: a metallic wind instrument, consisting of a tube which is usually convoluted, so as to make it more portable. It increases in diameter from the mouth-piece to the bell or flaring open extremity. It is provided with several longer or shorter mouth-pieces, by means of which the key is varied, and the whole is provided with valves and keys.

French Indo-China: See INDO-CHINA.

French Language [O. Eng. *frencisc* : Low Lat. *franciscus* : Ital. *francesco* : O. Fr. *franceis, françois* > Mod. Fr. *français*; orig. deriv. from the German tribal name, O. H. Germ. *franchun*, the Franks, spearmen, deriv. of a word meaning spear; cf. O. Eng. *franca*, lance]: that one of the Romance languages which is in most general use in France, though not the only tongue spoken in that country. The modern literary French has as its main source the Old French dialect of Paris and the surrounding territory, about what was later called Île de France, or, roughly speaking, the old duchy of France. The vocabulary has also been affected by other dialects—by Provençal words from the southern part of France, by borrowings from Italian, Spanish, English, and also from Latin, Greek, and some other languages. As the influence of Central French increased, the importance of the other dialects diminished, and they have long since sunk to the rank of *patois*, and are often mistakenly considered as mere corruptions of "good French" in the mouths of the ignorant. From the philological point of view they have much interest (a *Société des parlers de France* has been constituted), and in Old French they were extensively employed in literature. The political supremacy of Paris caused French to become the established literary language also in Southern France in place of Provençal, though the latter is still used in literature to some extent, and also to supplant in the same way the dialects sometimes called Franco-Provençal or Middle-Rhonish. In Western Brittany a Celtic dialect, the Breton, is spoken, closely related to Welsh; this is the result of an early immigration from Cornwall. In the southwestern corner of France Basque is spoken, Catalan in the extreme south, and Flemish in the extreme north. Corsica is linguistically Italian, and there are three small Genoese settlements in Southeastern France. On the other hand, French, as the spoken language, including Franco-Provençal dialects, reaches beyond the political limits of France, particularly into Western Switzerland and slightly over the northwestern border of Italy, Southern Belgium, also to some extent into the territory under German rule, though not reaching the Rhine, and the Channel islands belong linguistically to France. French is further spoken, more or less, outside of Europe in present or former colonies of France, as in Algeria, a large part of Canada (whence there has been a considerable immigration of French-Canadians into the U. S.) and Louisiana, to say nothing of Haiti, Guiana, Mauritius, and the extensions of French power in Africa and Asia. The various dialects spoken in consequence have considerable linguistic interest; for some idea of those of Canada and Louisiana, see articles in *The American Journal of Philology* and the publications of the Modern Language Association of America and of the American Dialect Society by Elliott, Fortier, Harrison, Chamberlain, and the undersigned.

The total number of those who speak French or some French dialect as their mother-tongue can not be given exactly. Suchier gives, in Gröber's *Grundriss der romanischen Philologie* (1888), 38,471,519 as the result of a careful computation; but this is for Europe only and includes speakers of Provençal dialects, and the census figures he uses are of somewhat different dates. Making allowances accordingly we may estimate the number at present as over 30,000,000. The language, in a form for the most part probably not very different from the Parisian French of the time (cf. Behrens in *Französische Studien*, v., and in Paul's *Grundriss der germanischen Philologie*, i.; also Suchier, *Altfranzösische Grammatik*, Halle, 1893), was brought into extensive use in England by the Norman conquest, and greatly affected English, so that a large number of the words in common use in English are from French. Besides this early Norman-French influence, English afterward borrowed much from the literary language of France. French has indeed exerted an influence on all the chief languages of Europe, through its literature and through the repute in which it has long stood as being the most polite and refined of the modern languages, and as possessing in a high degree the characteristics of precision and perspicuity, while the former political predominance of France on the continent of Europe assisted in giving its language a similar pre-eminence. These considerations explain also its extensive use in diplomacy.

The sounds of the modern standard language are as follows (a few which are of secondary importance or not universally recognized, though sometimes actually heard, are here omitted, and lack of a convenient and readily intelligible phonetic notation prevents minute exactness): There are twelve oral vowels: *i* (close, about as in English *machine*, never as in *hit*), close *e* (about as *a* in English *fate*, written *é*, also *e* without accent and *ai*), open *e* (as in English *pet*, *there*, written *è*, *e*, *ai*, *ei*), two varieties of *a*, one intermediate between English *a* in *fat* and *a* in *father*, the other more nearly like English *a* in *father*; close *o* (about as English *o* in *note*, written *o*, *ô*, *au*, *eau*), open *o* (somewhat like English *o* in *nor*, usually written *o*); *u* (close, about as in English *rule*, never as in *bull*, written *ou*), a vowel (written *u*) similar to German *ü*, but always close, to be obtained by pronouncing *i* with the lips rounded as for *u*, two vowels similar to German *ö*, and somewhat like English *u* in *burn*, one close, obtained by pronouncing close *e* with the lips rounded as for close *o*, the other open, being a similar combination of open *e* and open *o* (both usually written *eu*, but *œu* and *ue* also occur, as in *cœur*, *cueillir*), and a sound resembling English *e* in *battery*, the so-called "mute *e*," when really pronounced at all, always very short (written *e*). There are also four nasal vowels, nasalized forms of very open *e* (written *in*, *im*, *ain*, *ein*, *en*), of the second variety of *a* (written *an*, *en*, *am*, *em*), of an open *o* (written *on*, *om*), and of the open oral vowel commonly indicated by *eu* (written *un*, *um*). There are not less than twenty consonants: *p*, *b*, *f*, *v*, *w* (a consonantal *u*, written *ou*, *u*, *o*), a consonantal use of the vowel written *u* (as in *conduire*), *m*, *t*, *d*, *l*, *n*, *s*, *z* (the last six more dental than in English), sibilants like English *sh* in *shut* and *z* in *azure* (the former written *ch*, the latter *j*, *g*), a palatal *n* much resembling the sound of English *ni* in *union* (written *gn*), *y* (written *y*, *i*, *il*, *ill*), *k*, *g* (these two also with palatal forms as in English *key*, *gild*, compared with *cool*, *good*) and *r* (the uvular variety, but the older form trilled with the tip of the tongue is also permissible and is preferred by many). The sound of *h* as in English is given by some to the so-called "aspirated *h*"; this is its older sound, preserved in some dialects, but not generally recognized for standard French, where the only effect remaining of the former aspirations is to cause the preceding word to be pronounced as if followed by one beginning with a real consonant (*les hauts* with no *s* pronounced in *les*, compare *les autres* where the same *s* is sounded as *z*, *le haut*, *la haute* as contrasted with *l'autre*, where *l'* may represent either *le* or *la*). The accent, which is much weaker than in English, is on the last syllable of the word unless the vowel of this syllable is the "mute *e*," when it is on the preceding syllable. Unaccented vowels are not so slurred as in English. As appears from the various methods (incompletely given above) of writing the sounds, the usual spelling of French very imperfectly represents the language itself. The main cause of this is that the changes in the language since it began to be written have to a great extent not been recognized in its spelling, and even the early French spelling had to represent sounds not known in classical Latin by single letters or combinations of letters of the Latin alphabet. Thus *ai*, *ei*, *oi*, *au*, *eu*, *ou* once represented diphthongs with the stress on the first element, so that *ai*, for example, was sounded about as English *i* in *bite*, *au* somewhat as English *ou* in *loud*, *oi* (of which there were two varieties according to the quality of *o*) somewhat as in English *boil*, while the modern value of *oi* might be better expressed by *wa*. The sounds now written *eu* are of secondary development, though by no means only modern. The groups *il*, *ill*, in cases where they now mean *y*, formerly expressed a palatalized *l*, resembling *lli* in English *million*, and in those combinations of a vowel with a following *n* or *m* which now indicate nasal vowels the *n* or *m* was once fully pronounced, while the vowel had a nasal quality not always the same as in the French of to-day. Some sounds once existing have now disappeared; thus the oldest French had the consonant sounds written *th* and *ng* in English *thin*, *this*, *sing*, *l* followed by a consonant early changed into *u* in such words as *autre* (older *altre*), *chevaux*, plural of *cheval*, *s* before a consonant has been lost in such words as *été* (older *esté*), and final consonants have to a great extent become silent. Moreover, the older French spelling has in many cases been altered so as to agree more nearly with original Latin forms, or on account of the influence of other words from the same stem but with a different spelling. The usual Old French form from Latin *corpus* is *cors*, but an unpronounced *p* has been inserted from the Latin in modern French *corps*. The modern language has the written form *bœufs* as plural of *bœuf*, but the regular corresponding forms in Old French were *bues*, *buef*, the *f* regularly disappearing before the final *s*. In modern *grand* (compare Latin *grandis* and the French verb *grandir*) no *d* is ever pronounced, though *t* is sometimes heard instead before a word beginning with a vowel. The regular Old French spelling was *grant* (a feminine form *grande* also occurs), original *d* changing to *t* when final, and final *t* has since been lost regularly except when close connection with a following vowel in the next word has preserved it. This retention of an older final consonant sound only before a word beginning with a vowel is what is known as the *liaison* or linking. So final *s* has now regularly become silent, but in cases of *liaison* it usually stood between vowels, in which position *s* in French became *z* (in sound), hence the rule that *s* links with the sound of *z*. Similarly *g* (for older written *c* = *k*) links with the sound of *k*. The so-called "mute *e*" is now really mute in most cases, though still written at the end of words. Of course the changes in the language were gradual and were not all accomplished at the same time, some, as the loss of the sounds of English *th*, being hundreds of years older than others. The usual written form of French often disguises or conceals the inflexional history of the language by presenting old forms as actually still in use. This is particularly true for final letters, such as *e*, *s*, *t*, which play a large part in the inflexions of the language as written. Final *e* is common as a sign of the feminine gender, *s* is the usual sign of the plural in nouns, adjectives, and pronouns, and is frequent in verbs, as in the second person singular and elsewhere; but in the language as spoken the feminine is sometimes like the masculine, or differs from it by ending in a consonant which is lacking in the masculine, the plural is often like the singular, or differs from it by adding *z* before the next word, and verbal forms which differ in spelling are not always distinguished in speech or are distinguished by the accompanying subjects, especially pronouns; compare the written *grec, grecque, vrai, vraie, petit, petite, long, longue, longs, grand, grands hommes, tu as, il a, j'avais, tu avais, il avait, ils avaient, je viens, tu viens, il vient* with the spoken forms of the same words. But the spoken language is far from having lost entirely such distinctions as those made in writing, though they are not always made in the same way. Many changes in inflexions were also caused by analogy, the divergence from Old French not being brought about entirely by such regular changes in pronunciation as those mentioned, and it should also be remembered that some disagreement between the spoken and written forms of a literary language always exists. This disagreement is excessive and hence a serious defect in the case of French, though it is perhaps no worse than in English. One of the misfortunes resulting in great part from the loss of "mute *e*" is that French verse has acquired a somewhat artificial character, this *e* being still generally counted as the vowel of a separate syllable, while the number of syllables in the verse is a matter of great importance.

In the summer of 1893 a step was taken in the French Academy toward a moderate reform in orthography, proposals which permit a more consistent spelling of a considerable number of words being adopted by a small majority. The following examples will illustrate some of the most important changes in spelling proposed: *seur* for *sœur*, *sistème* for *système*, *filosofie* for *philosophie*, *rétorique* for *rhétorique*, *astme* for *asthme*, *cronologie* for *chronologie*, *honeur* for *honneur* (cf. *honorer*), (*il*) *appèle* for *appelle*, *genous* for *genoux*, *chevaus* for *chevaux*, (*je*) *veus* for *veux*. Among other things, further, the use of hyphens is much restricted and that of accents somewhat changed. It is to be hoped that these reforms will find general acceptance.

In its inflexional system French has the grammatical gender, nouns, adjectives, and pronouns being masculine or feminine, but the neuter gender has been practically abandoned. In the personal pronouns some true case forms are found, while nouns have wholly lost the distinction of cases. The so-called disjunctive (accented or emphatic) and conjunctive (unaccented) forms of pronouns are also a feature of the language; compare in English *tell 'im* (unemphatic) with *tell him* (emphatic). The infinitive endings, according to which verbs are classified into conjugations, are written *-er, -ir, -re, -oir*, but only verbs of the first two classes belong to still really living conjugational types, according to which newly formed verbs may be inflected. The simple tenses, not formed by the aid of separate auxiliary words, are the present, imperfect, past ("parfait défini" or aorist, as it might be called, which has almost wholly disappeared from use in conversation, its place being taken by the compound present; *j'ai fait* = "I have done" and "I did"), and future of the indicative mood, a present of the so-called conditional mood, corresponding to English "should" or "would," a present and a past of the subjunctive, and a simple imperative. There is a present active participle and a past participle (passive in transitive verbs). Tenses for which there are no simple forms are supplied by using auxiliary verbs (*avoir*, "have," or *être*, "be") with the past participle, and the passive voice is formed by *être* and the past participle. But the passive is less used than in English, reflexive forms or active forms with the indefinite subject *on* (*on dit*, "they say," "it is said") being largely used instead. The use of all these forms is determined for the written language by grammatical rules, some of which, particularly those for the inflexion of the past participle, are complicated and somewhat artificial. The method of negation is peculiar, two words being generally required, the old simple negative *ne*, "not," being in most cases accompanied by an additional adverb or pronominal word after the verb; *ne . . . pas* = "not," *ne . . . aucun* = "not any," "no," *ne . . . personne* = "not anybody," "nobody," but this accompanying word (originally negative in some cases, positive in others) is sometimes used as a negative by itself, when the verb is omitted, without which the *ne* can not be used. The language abounds in idiomatic uses of *ne* and various other words, having many phrases whose precise meaning is not at once obvious from the meanings of the individual words employed. Of the studies on special points of French syntax the best are to be found in Tobler's *Vermischte Beiträge zur französischen Grammatik* (Leipzig, 1886), and in his later papers with the same title in the *Zeitschrift für romanische Philologie*. French forms compound words less freely than either German or English, but is by no means so poor in compound nouns as is sometimes supposed.

The history of the French language begins with popular Latin, which, as spoken in Gaul, gradually assumes a form distinct enough to be called no longer Latin. For convenience, according to documents preserved, the Old French period may be considered as beginning in the ninth century (the Strassburg oaths, 842) and as extending into the fourteenth. The convenient characteristic for this period is the declension of nouns with two cases, a subject and an object. For the study of this period, see, for example, G. Paris, *Extraits de la Chanson de Roland* (4th ed. Paris, 1893); Suchier, *Altfranzösische Grammatik* (Halle, 1893, ff.); Godefroy, *Dictionnaire de l'ancienne langue française*, etc. (Paris, 1881, ff.); Gröber's *Grundriss der romanischen Philologie*, and other works mentioned in the article on the Romance languages. The period following this and preceding modern French (which may be said to begin after the sixteenth century) is a transitional one, though the language was of course not free from change during the Old French period. For the sixteenth century should be consulted Darmesteter et Hatzfeld, *Le seizième siècle en France* (Paris, 1878), and Thurot, *De la prononciation française depuis le commencement du XVI^e siècle* (Paris, 1881). It was not until the sixteenth century (1539) that the use of French was made obligatory in public documents in place of Latin, and the grammatical treatment of the language in this and the following century was under the influence of the Latin grammar, the historical continuity with Old French being ignored, and the early stages of French being neither understood nor studied by grammarians and critical writers in general. Moreover the conscious efforts of those who aimed at ennobling and refining the language were not without some influence. In 1635 the French Academy was established, following the example of the Accademia della Crusca in Italy, and its decisions in matters of spelling and usage were to be authoritative. The first edition of the *Dictionnaire de l'Académie* appeared in 1694, the seventh in 1878.

For some account of the relations of French to the other Romance languages and to Latin, see ROMANCE LANGUAGES. The following list of works on the language, in addition to those already mentioned, must also be supplemented by reference to the same article, for the modern language can not be fully understood without a knowledge of its history.

DICTIONARIES.—Littré, *Dictionnaire de la langue française* (Paris, 1863–72), and *Supplément* (1877); Darmesteter, Hatzfeld and Thomas, *Dictionnaire général de la langue française* (Paris, in course of publication): Larive and Fleury, *Dictionnaire français illustré des mots et des choses* (Paris, 1891); and older works in France, as Poitevin, *Dictionnaire universel* (1856–60); Bescherelle, *Dictionnaire national* (1843–46), and others: Sachs, *Encyclopädisches Wörterbuch der französischen und deutschen Sprache* (Berlin, 1869); French-English dictionaries such as those of Smith, Legros and Hamilton, Gasc, and others, notably the wonderfully condensed and yet for its size very full dictionary for the pocket (of both languages) of John Bellows; Godefroy, *Lexique comparé de la langue de Corneille*, etc. (1862); Génin, *Lexique de Molière* (Paris, 1846): Lafaye, *Dictionnaire des synonymes de la langue française* (Paris, 1858); the etymological dictionaries of Scheler (1st ed. 1862) and Brachet (1st ed. 1870). Grammar, including pronunciation and formation of words (in French): Ayer, *Grammaire comparée de la langue française* (4th ed. 1885); Benoist, *De la syntaxe française entre Palsgrave et Vaugelas* (Paris, 1877); the recent grammars of Brachet (*Nouvelle grammaire française*; his *Grammaire historique* is antiquated), Chassang (*Nouvelle grammaire française, cours supérieur*), Clédat (*Nouvelle grammaire historique du français*); *id.*, *Précis d'orthographe et de grammaire phonétiques* (Paris, 1890); A. Darmesteter, *Traité de la formation des mots composés dans la langue française* (Paris, 1875); *id.*, *De la création actuelle de mots nouveaux dans la langue française* (Paris, 1877); *id.*, *Reliques scientifiques recueillies par son frère* (Paris, 1890); A. F. Didot, *Observations sur l'orthographe française* (Paris, 1867); Koschwitz, *Les parlers parisiens* (Paris, 1893); Lesaint, *Traité complet de la prononciation française* (2d ed. Hamburg, 1871); Livet, *La grammaire française et les grammairiens du XVI^e siècle* (Paris, 1859); Mende, *Étude sur la prononciation de l'e muet à Paris* (London, 1880); Mercier, *Histoire des participes français*

(Paris, 1879); P. Passy, *Les sons du français* (3d ed. Paris, 1892); see also his and other articles in the *Phonetische Studien*; (in German or English) Beyer, *Französische Phonetik* (Cöthen, 1888); Beyer und Passy, *Elementarbuch des gesprochenen Französisch* (Cöthen, 1893, with an *Ergänzungsheft*); Breymann, *A French Grammar Based on Philological Principles* (London, 1874); Koschwitz, *Neufranzösische Formenlehre nach ihrem Lautstande dargestellt* (Oppeln and Leipzig, 1888); Lücking, *Französische Grammatik für den Schulgebrauch* (Berlin, 1883); Mätzner, *Syntax der neufranzösischen Sprache* (Berlin, 1843); *id.*, *Französische Grammatik* (2d ed. Berlin, 1877); Niemer, *Die orthographischen Reformversuche der französischen Phonetiker des XIX. Jahrhunderts* (Greifswald, 1882); Stengel, *Chronologisches Verzeichniss französischer Grammatiken vom Ende des 14. bis zum Ausgange des 18. Jahrhunderts* (Oppeln, 1890); Whitney, *A Practical French Grammar* (New York, 1886), etc.; see also the works mentioned in Gröber's *Grundriss der romanischen Philologie*, and many articles in periodicals. Versification: L. Becq de Fouquières, *Traité général de versification française* (Paris, 1879); Lubarsch, *Französische Verslehre mit neuen Entwickelungen für die theoretische Begründung französischer Rhythmik* (Berlin, 1879); C. Tisseur, *Modestes observations sur l'art de versifier* (Lyons, 1893); Tobler, *Vom französischen Versbau alter und neuer Zeit* (2d ed. Leipzig, 1883; French translation, 1885), etc. Dialects, etc.: Gilliéron and Rousselot, *Revue des patois gallo-romans*; Clédat, *Revue de Philologie française et provençale* (originally *Revue des patois*); and many special studies by Gilliéron, Joret, Horning, and others; see Gröber's *Grundriss* and periodicals. E. S. SHELDON.

French Literature: French literature may be divided for the sake of convenience into six periods—the first, from the earliest beginning to the second third of the fourteenth century, or the accession of the house of Valois—a period chiefly devoted to the expression of feudal and knightly society; the second, to the end of the fifteenth century (the boundary commonly assigned to the Middle Ages), reflecting more particularly the life and ideas of the bourgeoisie; the third, including the sixteenth century, i. e. the period of the Renaissance; the fourth, the period of French classicism, coinciding roughly with the seventeenth century; the fifth, sometimes called the Age of the Philosophers, comprising the eighteenth century down to the Revolution; and the last, the period of realism, extending from the Revolution.

French literature began as soon as national consciousness was awakened in the population of Northern Gaul after the Germanic invasions of the fifth and sixth centuries A. D., or, in other words, when the various elements that had been brought together there had so far been fused as to produce a community of sentiment and of culture in general. First of all these elements was the Celtic blood of the great mass of the Gallic population; though the vague but important contribution of a certain mental and moral temperament was about all the original Celtic inhabitants of Gaul made to the national inheritance of their descendants. Their institutions, religious and civil, and their language were replaced by those of Rome. Their civilization, in a word, was Latinized; and this Latin culture was the second ingredient of the forthcoming nationality. A third, coming in the train of Roman conquest, and partly mastering, partly neutralizing, Latin culture was Christianity, with its conceptions of man and the world, and its positive institutions of a visible church. The fourth ingredient of the compound was furnished by the ideas, institutions, and spirit which the Teutonic invaders brought into contact with the Christianized Gallo-Roman population they had conquered.

As it was a Germanic people that gave the new nation its name of France, so it was this youngest element of the French nationality that was the starting-point of the most vigorous and flourishing part of its first poetic production—the heroic poems or *chansons de geste*. The fruitful germs of the rich literature of *chansons de geste* lie in the memories of the exploits of the royal houses of the Franks, from the time of Clovis downward, and of those military successes or reverses through which, under the Frankish kings, the national spirit became conscious of itself. The original productiveness of this epic impulse ceased with the beginning of the eleventh century, when feudalism appeared fully constituted, but the materials which it had created continued to be worked over for a long time, and all the extant poems of this period owe their present form to later hands.

Two groups of the *chansons de geste* are distinguished. Those of the earlier came from a society in which the dominant sentiment was that of national unity, and their august central figure is Charlemagne, about whom memories of various older and later times have gathered. One of the earliest, and certainly the most famous, of all *chansons de geste*, the *Chanson de Roland*, composed in the second half of the eleventh century and contained in a manuscript a century younger, belongs to this group. The later group reflects a society in which feudalism, with its impatience of royal control, was the inspiring force (*Renaud de Montauban*, *Girard de Roussillon*).

The *chansons de geste* are mainly anonymous. They were composed to be sung or recited to a musical accompaniment, as the public to which they were addressed could not read. Their form, admirably suited for this method of publication, consists of groups of from five to several hundred lines of equal length, in the *Roland* of ten syllables, bound together by assonance of the final vowels.

Of considerably later inspiration and generally of somewhat later composition, addressing also a special class of patrons in those who were beginning to make a polite and courtly society at the castles of those rich nobles whose taste began to turn from war to display, luxury, or the cultivation of the forms of intercourse, and especially influenced by the part of women in this society and the ideals to which that gave rise, were the courtly poems celebrating chivalry and adventure. These expressed the ideals of courtly society; their heroes are not so much warriors as early types of the modern gentleman. They flourished particularly in the hundred years following the middle of the twelfth century, when the works of the most popular and brilliant author of poems of this kind, Chrétien de Troies (*Tristan*, *Erec*, *Cligès*, *La Charrette*, *Ivain*, *Perceval*, between 1160 and 1175), did much to establish their vogue. Their subjects were taken from various sources: The literature or traditions of antiquity (*Alexandre*, by Lambert le Tort and Alexandre de Bernai, whence the name of the line that became the basis of the verse-form of classic French tragedy; *Troie*, by Benoit de Sainte-More; *Enéas*), from floating Oriental tales (*Sept Sages de Rome*, *Aucassin et Nicolette*), and especially from Celtic tradition (*Tristan*, *Erec*, *Ivain*, etc.), which furnished King Arthur and the knights of his Round Table. These heroes of Celtic origin became enormously popular, and in them particularly the age of chivalry embodied its conceptions of polite life. The ordinary form was rhyming couplets, and the short line of eight syllables was particularly favored.

As was the case with the *chansons de geste*, the courtly poem continued to be cultivated after the ideas which gave it birth had ceased to have creative power. While its subjects were still popular, continuations of incredible lengths (60,000 lines) were added to the adventures of favorite heroes. As interest waned the poems were abridged. They were among the first compositions to pass into the prose form, rendering thus a real service to prose style, and were the forerunners of the modern novel.

With the *fableaux* one passes rather to the region of lower and common life and the horizon of the bourgeoisie. The *fableaux* are short tales in verse, usually extremely coarse in subject and frank in treatment, but redeemed sometimes by their shrewd observation of men or by a thrust of genuine wit. The society which they picture is that of the common people; the peasants and clergy are oftenest the target of their ridicule, and woman plays in them a very different *rôle* from that given her in the heroic or courtly poetry.

From the same region of society, and having the same main interest of incident with a very prominent satirical intent, were the stories of animals brought together in the twelfth and thirteenth centuries under the name of the *Roman de Renard*. In these stories the well-known adventures of *Renard*, the fox, *Isengrim*, the wolf, *Chanticler*, the cock, and the rest are told with a clearer and clearer reference in the later versions to human society.

The growing allegorical tendency thus seen in the stories of animals was very characteristic of the latter part of this period of the Middle Ages. The mediæval mind was inclined to regard things as mysterious symbols to be interpreted in the light of its already formed conception of the world, and to draw from everything a moral or spiritual meaning which was its real explanation. A large portion of the didactic literature of this period, which mainly, it is true, started from the clergy, but was composed in view of the people at large, was essentially allegorical. The sermons of the time are noticeable for their *exemples*, or parables, of homely sort, by which the instruction was made more vivid. Of the same allegorical nature were the *débats* and the personifications in which the religious literature of the thirteenth and fourteenth centuries abounds. Even works intended for scientific instruction used the same method. The stone-books (*lapidaires*), enumerating the peculiar properties attributed to precious stones, and the beast-books (*bestiaires*), which do the same thing for animals, add often the allegorical interpretation in moral terms of these properties. Indeed, science in the Middle Ages consisted largely in a half-allegorical interpretation of natural objects and phenomena. The profound curiosity to know the meaning of them as symbols was perhaps a reason why they were not observed more exactly as facts.

The work which represents the greatest achievement of the allegorizing spirit and whose instant and amazing success is a sign of its harmony with the taste of the time is the *Roman de la Rose* (begun by Guillaume de Lorris about 1237, finished by Jean de Meun about 1277). The subject of the poem is the attempts of Lover to pluck the Rose in the garden of Love, favored or hindered by Welcome, Danger, Slander, Shame, Fear, and others of the allegorical train. In the wake of the popularity of this work the allegorizing spirit went far beyond the boundaries of France and of this period, and signalized its strength in the next by its conquest of the drama.

The drama, which had its birth in the Church in the dramatic illustration, at first very meager, given the service on the great feast-days of Christmas and Easter, hardly outgrew during this period its dependence upon the service, though the scenes enacted from Old Testament and New Testament history had proven their charm upon the people, and began to be brought together in large groups (mysteries). The drama of purely profane subject did not arise till later. Adam de la Halle (b. about 1240) left two noticeable plays dealing with common life (*Jean de la Feuillée*, *Robin et Marion*), and from a very early date the religious plays were not without scenes where a comic or satiric spirit introduced pictures of contemporary life. And probably aside from these recorded examples the comic spirit of the age never ceased to deal dramatically with life, for some of the earliest farces that have come down from a later period do not seem to be creations in a new and unpracticed field.

French lyric poetry of this period was mainly dominated by Provençal influence. A few examples remain of an older lyric apparently native to Northern France, characterized by great simplicity and grace in form and content. But with the twelfth century the lyric poets of renown (Gui de Coucy, Chrétien de Troies, Blondel de Nesle, Tibaud de Champagne, etc.) all cultivated the forms and subjects of the troubadours; societies of artisans and tradesmen (*puis*) also applied themselves to the lyric art, and gave great elaborateness to the form and great monotony to the contents, though occasionally there was among them a man of real genius (Adam de la Halle, 1240–70, Rustebœuf, 1255–85).

Prose in this period hardly held the conspicuous place in French literature that it has since held. It was employed in translation from the Latin, which did not easily surrender its title as the only vehicle of really serious knowledge, and was successfully cultivated also by the writers of the prose romances of chivalry. But already the long series of great monuments of French prose had been opened by Villehardouin in his chronicle of the fourth crusade (1198–1207), and it was worthily continued by Joinville in his history of St. Louis (1300–09). But to the end of this period verse was still mainly preferred for all historical works in French (Gaimar, *Histoire des Anglais*, 1147–51; Wace, *Geste des Bretons*, 1155; *Roman de Rou*, 1160–74).

With the fourteenth century and the Hundred Years' war the middle portion of society comes definitely to the foreground in literature. The subjects and sentiments that had inspired the rich growth of *chansons de geste* and poems of chivalry had ceased to interest. Literary activity in these fields spent itself in attempts to rejuvenate the form of older poems and adapt their matter to the changed taste. Prose asserted its supremacy, and the old heroic songs, shorn of the epic formulas that had proved burdensome to them, regained in the shorter prose a considerable portion of public favor, which they still retained when the art of printing came to attest their popularity by sending some of the prose romances of chivalry forth among the first products of the press.

The field of lyric poetry was not so barren. After the lyric had been reduced to a mere matter of formal technique, and its productivity seemed exhausted, Guillaume de Machault opened up new possibilities for it, and a new series of forms was created, many of which, as the *ballade*, *rondeau*, *rondel*, *triolet*, etc., have been restored to new life and favor in our day. But some of these lyric poets were noticeable for more than technical excellence of form. François Villon (middle of the fifteenth century) particularly seems to cut loose from the Middle Ages by emerging from the conventional round of ideas that lyric poetry had expressed, and by asserting passionately and with poignant directness his own personal view and sense of things.

To the biblical and legendary drama (mystery, miracle) the bourgeoisie gave in this second period a great expansion, and it became the medium of whatever public relation with literature there was. The *puis* (see above) in all the considerable cities undertook the presentation at stated intervals of mysteries and miracles, which came to be of great length, and these were occasions of great public importance in the community. Allegory, that had so invaded literature in other directions, took possession of the drama also: and the morality, which is merely an allegory dramatized, became immensely popular. In them the native humor of the people and the *esprit gaulois* found vent, as in the farces to which they gave place, some of which are written with great comic vigor and considerable skill (*L'Avocat Pathelin*, fifteenth century). The spirit of satire and ridicule, which found abundant material in the decadent institutions and society of feudalism, ran riotous course in the *sotties*. At Paris, which here as often elsewhere resumes the intellectual life of France, these three kinds of dramatic representation were the especial care of three societies—the Confrêres de la Passion, the Basochiens, and the Enfants sans souci.

A somewhat kindred spirit of criticism distinguishes the historical work of the end of this period, the *Memoirs* of Philippe de Comines, from the *Chronicles* of Froissart which relate its beginning. Froissart is the vivid anecdotist, accepting completely the forms of that life which he pictured with such detail and color without questioning their authority. Comines, though an unmethodical chronicler, brings men and events to the test of a more reasonable order to be established.

The great movements of the sixteenth century in France, as in Europe generally, were the Renaissance and the Reformation. The Reformation agitated France profoundly, and contributed directly to literature in the fields of lyric poetry (songs of the Huguenots) and of vigorous argumentative prose (Calvin, 1509–64). But failing to penetrate the masses of the people, it succumbed to the strong impulse toward national unity, and did not deeply and permanently inform literature as in Germany and England. But the Renaissance produced a very complete transformation. Not only was the mind, somewhat baffled in its search of fruitful developments of the mediæval way of looking at life, fascinated with the new conceptions that contact with the antique world gave it, but it was charmed by the forms and art of the literatures which revealed them. Compared with them the native language and literature seemed uncouth and barbarous. Men looked upon Greek and Latin as the great models, and addressed themselves ardently to the task of reforming their own in their semblance. Their efforts, more zealous than well considered, are visible in all directions, and give to the productions of the century, with all their vigor and vitality, an appearance of confusion that is sometimes almost grotesque.

The great representatives of the century on the side of its ideas were François Rabelais (1483–1553) and Michel de Montaigne (1533–92). Rabelais's famous works, *Gargantua* and *Pantagruel*, in which the whole decaying mediæval world appears in fantastic and grotesque combinations with ideas and scraps of knowledge of all kinds crammed together from all sources, is, as it were, the boisterous laughter of the old spirit of the *fableaux* and the *sotties* standing at the outer threshold of the Middle Ages and tipsy with the wine of new learning. Montaigne's *Essays* belong more pronouncedly to the new age. They are the reflections, thrown together in agreeable disorder, of a man who views the world seriously, but amiably despairs of finding it intelligible as a whole, and whose essential skepticism allies him with the minds of the eighteenth century, who were the first to make him popular.

On the formal side the characteristics of the period were most noticeable in lyric and dramatic poetry. In the drama, though in Paris the representation of mysteries was forbidden because of the license which had invaded them, the old popular theater survived and even preserved a certain vitality. But a flood of translations and imitations of works of classical antiquity was invading the schools, drawing their inspiration from the Latin rather than the Greek authors; and the first forerunners of Corneille (Jodelle, 1532–73; Garnier, 1545–1590) were beginning the tradition of classical French tragedy. In lyric poetry Clement Marot (1495–1544) forms a connecting link with the foregoing period, and both in the strong old words of his language and in the forms of his verse continued the tradition of the fifteenth century. Pierre de Ronsard (1524–85), on the other hand, with his coterie, self-styled the *Pléiade* (foremost in which was Joachim du Bellay (1524–60), whose *Défense et Illustration de la langue française* expresses the aims of the group), led the movement to renew the language and literature; and his works—odes, sonnets, and imitations of Vergil—are stuffed with bold adaptations of Greek and Latin words and idioms. The result was enrichment of the language and literature, but almost their suffocation also. A critical process of selection and ordering was necessary, and a standard to regulate and check the excesses of individual zeal. These were inaugurated by Malherbe (1555–1628). Without original genius, he yet became the dominant force in French letters because he answered most fully the needs of the moment for definite standards and rules by which order and measure might be attained. Thus in harmony with the impulse of his time he largely impressed upon the dawning seventeenth century that character of repression, severe regularity, conformity to standard, which the classical period wears.

This character, favored by the great movement toward a central authority which came to all currents of French life with the final victory of the monarchy and the prestige of a brilliant court, felt more and more since Francis I. as the center of national life, gave to the literary productions of the seventeenth century a singular unity, which French society and institutions of the time also reveal. The French mind for the time exalted authority and the value of unity and order. In literature the authority of the ancients was easily and naturally accepted, and Aristotle became supreme arbiter in all questions about which he could be forced to give an opinion. In the drama, which, since the establishment of a regular dramatic company (about 1600), was preserving the prominence it had won in its older forms, not only the inferior talents (Hardy, 1570–1631; Mairet, 1604–86; Rotrou, 1609–50), but Corneille (1606–84) as well, whose masterpiece, *Le Cid* (1636), followed within a few years by *Horace*, *Cinna*, and *Polyeucte*, captivated the public and decided the formula of French tragedy, wished to apply those rules of dramatic composition which they supposed the ancients had followed. Racine (1639–99) moved with more freedom and ease in the form thus fixed, not because he expanded it in any wise, but because he naturally felt its limitations less, choosing, mainly from classical sources (*Alexandre*, *Andromaque*, *Britannicus*, *Mithridate*, *Iphigénie*, *Phèdre*), subjects which may be successfully developed within the narrow limits of time and place which the formula allowed. Comedy, which also owed to Corneille its first successful cultivation (*Le Menteur*, 1644) according to the taste of the time, developed more freely in the hands of the greatest literary genius of the century, Molière (1622–73), who, actor himself and theatrical manager, worked out his comic style, not without influence from the Latins directly or through translations, but in immediate touch with the feeling of the society about him, and taking as his point of departure the free comedy of situation and intrigue which was the special property of Italian troupes. By enlarging the part of observation he laid the great interest of his most serious works (*Le Misanthrope*, *Tartuffe*, *L'Avare*, *Les Femmes savantes*) in the lifelike presentation of well contrasted characters, and established the tradition of the comedy of character, which held its supremacy long after his time, and in which his most brilliant follower was Regnard (1655–1709).

Other poetry than dramatic did not greatly flourish in the age of Louis XIV. Epic breadth and elevation and lyric intensity and fervor were alike wanting. Only where these qualities are not of prime importance was work of distinction achieved, as in the fable and short story in verse in which La Fontaine (1621–95, *Fables* and *Contes*) produced masterpieces marked by brilliant perfection of versification and great alertness and grace of style.

The same craving for authoritative standards that fastened the rules upon classical tragedy dictated those grammatical and lexicographical works, beginning with the dictionary of Vaugelas (1585–1650), which had for their aim the precise definition of good usage and the consequent purification of speech, and presided also over the foundation of the French Academy (1635), which has since continued to guard so jealously the purity and dignity of the language. The house of Rambouillet, though leading to an extreme affectation, was but another expression of the same tendency. The qualities that the seventeenth century thus came to prize most highly are nowhere better set forth than by Boileau (1636–1711), who in his *Art poétique* formulated the critical canons of the age, the central demand of which was for lucidity, moderation, and common sense.

The application of such a standard was far more favorable to prose than to poetry, and the conversation in the salons of the day, as well as the letters of professed cultivators of prose style like Balzac (1597–1654) and Voiture (1598–1648), the pastoral romances brought into vogue by d'Urfé (1568–1625; *Astrée*) and the nominally historical novels of Mlle. de Scudéry were both developing its resources, giving it polish and fixing its forms. At the same time Descartes (1596–1650), whose philosophy supplied the basis of that spiritualistic conception of man which the classical literature mainly applied, and especially Pascal (1623–62), whose *Lettres provinciales* in defense of the suspected Jansenists of Port Royal were, by the admiration they excited and the circulation they received, particularly influential, were giving French prose the firm lucidity and precision which have continued to distinguish it. The letters of Madame de Sévigné (1626–96) show with what charm and force the language was habitually used by one who was not a professional writer. An ornate and impressive rhetoric was cultivated in the pulpit by Bossuet (1627–1704) in his celebrated funeral orations, Bourdaloue (1632–1704), Fléchier (1632–1710), and Massillon (1663–1742). Bossuet, furthermore, a man of really comprehensive mind, made himself the great apologist of the Catholic system by interpreting according to its ideas history (*Discours sur l'histoire universelle*), philosophy (*De la connaissance de Dieu*), and politics (*Politique tirée de l'Écriture Sainte*). The moralists La Rochefoucauld (1613–80; *Les Maximes*) and La Bruyère (1645–96; *Les Caractères*) enlarged the capacity of prose for delicate discrimination and condensed epigrammatic statement; and Fénelon (1651–1715) gave it in his political romance *Télémaque* a new harmony and rhythm.

The unity which is the conspicuous outward mark of the seventeenth century was not unbroken. There were not wanting voices, drowned for the time under the overwhelming chorus of assent, that appealed from the generally accepted standard, in state, in Church, and in taste. Against the authority of the ancients the equal or greater value of modern example was upheld. In the eighteenth century the dissenters gained more and more in numbers, but still without visibly weakening the established tradition. Voltaire (1694–1778) and Crébillon (1674–1762) continued to write tragedies in the manner of Corneille and Racine, and Destouches (1680–1754), Marivaux (1688–1763), Piron (1689–1773), and Lesage (1668–1747) followed, with such deviations as their talents imposed, the footsteps of Molière. Narrative poetry remained unproductive, not even the literary dexterity of Voltaire being sufficient to give real vitality to his serious (*Henriade*) and burlesque (*Pucelle*) attempts in this direction. In the lyric field J. B. Rousseau (1670–1741) composed odes of some technical finish and elegance, but without lyric impulse. The wholly rational drift of the century, with the stress it laid on logic and reason, was not calculated to lessen the respect paid to the qualities of proportion, lucidity, and good sense extolled by Boileau, and on the whole defended the old rules against attack. La Harpe (1739–1803), who is said to have created literary criticism in France, rigorously upheld the undiminished validity of the literary doctrines of the seventeenth century.

But the great movement of the century toward enlightenment, impelled by the feverish intellectual curiosity which characterized it, and of which the great *Encyclopédie* of Diderot (1713–84) and d'Alembert (1717–83) is the typical expression, was all the while bringing forth ideas completely subversive of that spiritualistic and aristocratic conception of life upon which the literary practice of the seventeenth century had been based, and forcing upon attention subjects that had lain quite without the circle of its sympathy and interest. The Cartesian philosophy was abandoned for the English sensationalism, and the *Esprit* of

Helvetius (1715–71), the *Système de la Nature* of d'Holbach (1723–89), and the writings of the other Encyclopédistes asserted a pronounced materialism. This entire shifting of the point of view, laying stress on the outer world rather than on the mind, lent a great impulse to the study of the natural sciences, and Buffon (1707–88) was but the most illustrious of a great number who applied themselves eagerly to the observation of nature. The comparative study of political institutions, as Montesquieu (1689–1755) conducted it, robbed the institution of royalty of its special authority. The society which afterward became the Société des Inscriptions et Belles-Lettres began to renew acquaintance with that national past upon which French literature had turned its back since the Renaissance, and to find there a various and multiform life of which the great century had been unconscious or disdainful. Foreign literatures also began to open to view other canons of taste than the ones that had ruled classicism. Of especial influence were the works of Shakspeare and the poems of Ossian, both translated within twenty years of the Revolution by Letourneur. At the same time, the complete ascendency of logic, lucidity, and common sense, with which, as has been said, the drift of the time was in full accord, was threatened by the sentimentalism of Jean Jacques Rousseau (1712–78), who, in discussions of politics (*Contrat social*) and of education (*Émile*), in fiction (*La Nouvelle Héloïse*) and in autobiography (*Confessions*), exalted the voice of feeling to an authority at least equal to that of reason.

These elements of a new conception of life became effective for literature but slowly. Rousseau exerted the most profound direct influence by the fascinating and brilliant style by which he dazzled not only his own but subsequent generations; and Bernardin de Saint-Pierre (1737–1814) was the first of a long line of disciples who combined, like their master, sentiment and nature (*Paul et Virginie*). The emotional element appeared again, in combination this time with the more democratic conception of society, in the sentimental comedy of common life inaugurated, under English influence, by de la Chaussée in the middle of the century, and defended in theory and practice by Diderot. The influence of the same democratic conception of society may be detected in the realistic tendency of Le Sage's most vital work, *Gil Blas*.

It was not till after the great breaking up of all the old forms of life in the Revolution that conscious and noticeable attempts were made to deduce the literary consequences of the new order of ideas; or, what is the same thing, to create a literature that should adequately reproduce and interpret life from these changed standpoints, and as affected by these new elements that were seen to enter into it. To do this was the task of the romantic school, whose inspiring principle was to bring literature closer to the reality of man and nature—seeing in nature a capacity to influence man emotionally, and regarding man in the concrete as the infinitely various spirit that history shows, and in the abstract as that absolute being assumed by the Revolution, created free and equal, from whose capacities the limitations of unnatural institutions were forever done away by the return to liberty. Chateaubriand (1768–1848) sought in history (*Génie du christianisme*) inspiring examples of the reality and power of those forces of life which classicism had largely ignored; and in the figures created imaginatively out of his own experiences (*René*, *Atala*) he reproduced the boundless aspirations, the unfettered license of desire, thought, and will, which belong to this revolutionary conception of man. Madame de Staël (1766–1817) drew from her own experience somewhat similar figures (*Corinne*, *Delphine*), and performed furthermore the signal service of opening to the French public of letters the strange and stimulating world of German poetry and philosophy. In Lamartine (1790–1869) was opened a fountain of pure poetic feeling of essentially lyric and elegiac quality that had long been sealed in France. But Victor Hugo (1802–85) first successfully formulated the principles of the new movement, declared the total inadequacy of the classical forms, and consciously founded a school. The early volumes of lyrics and dramas (*Odes et Ballades*, 1826; *Orientales*, 1828; *Cromwell*, 1827), in which he strove to render the variety, color, and striking contrasts that he found everywhere in life, he accompanied with prefaces theoretically defending his practice. He met with violent opposition—a sign of the tenacious persistence of the classical tradition—but was supported by an enthusiastic band of devoted followers. The performance of *Hernani* in 1830 has been regarded as the critical moment of the battle of romanticism; and from that time it was dominant. Victor Hugo continued throughout his long life to be true to the general conceptions of life and art that he defended in the prefaces of his first volumes. Of the group of his ardent supporters of 1830, however, most were more loyal to the spirit of the romantic movement than to Hugo's own formulation of it, and soon turned away from a style of representing life that seemed to sin against reality by emphasis and exaggeration. So Alfred de Musset (1810–57), whose impulse came wholly from romanticism, took after 1830 a somewhat reserved attitude toward the school of Hugo. His fervid lyrics are peculiarly his own, the expression of that capacity for passionate and emotional experience which was his great gift. Gautier (1811–72) alone of the better talents of the first enthusiasm remained devoted to Hugo, though he inaugurated a further development of the poetic creed by a special emphasis on form, and became thus the master of a new generation of poets of the second empire, the *Parnassiens*.

In prose the romantic spirit, which had drawn so much of its inspiration from history, signalized itself by creating a brilliant school of historians, Raynouard (1761–1836), Guizot (1787–1874), Augustin Thierry (1795–1856), Mignet (1796–1884), Michelet (1798–1874), and many less illustrious. It also showed kinship with history by compelling almost all fiction for the moment into the historical form, and thus starting the novel on a new phase of development which it has since mainly followed. Of those novelists who had conspicuous success in the years about 1830, Victor Hugo, Alfred de Vigny (1797–1863), Alexandre Dumas (1803–70), Honoré de Balzac (1799–1850), and George Sand (1804–76), only the last, who was consumed by her passionate revolt against society, and absorbed in her attempt to apply the conceptions of revolutionary man to contemporary institutions, failed at least to serve an apprenticeship in the historical novel.

Since 1850 both poetry and prose, in harmony with the growth of the democratic idea and the changed conceptions which the conquests of the physical sciences have produced, have ascribed an increasing value to commonplace persons and events, and to material things. The doctrine of "art for art's sake" of the *Parnassiens* involves the supremacy of the external, material form, and the realistic tendency in the novel, which has continued the movement of romanticism, has more and more sought its criteria of reality in extreme democratic and materialistic conceptions. The novelists who represent the successive phases of the realistic novel, de Balzac, Flaubert, de Goncourt, and Zola, show plainly how literature in the latter half of the century has drawn its interpretation of life more and more from the physical sciences. The method of impassive observation and tabulation of phenomena, which has been such a formidable weapon in the hands of these sciences, is demanded for literature also. Its employment in the fields of historical and literary criticism by Renan and Taine, with more or less rigor according to the temperament of each, has produced the most conspicuous examples of later French criticism.

Since 1885 a tendency is perceptible to demand of poetry again a greater emotional and ideal content, and to insist more strenuously upon the reality and value of the moral and spiritual forces of life. Of this the various confused groups of *décadents* and *symbolistes*, and the more coherent movement, sometimes called "Neo-Christian," are expressions. It seems doubtful whether in most cases this tendency rests upon an intellectual conviction of the truth of the conceptions of life sought, or on a patriotic belief that, were they present, they would be favorable to the perpetuity of the national vigor.

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French Lick: post-township of Orange co., Ind. (for location of county, see map of Indiana, ref. 10–D). French Lick Springs, saline and sulphur waters, are some twelve in number, and are situated in a delightful valley, 9 miles from Georgia station on the Ohio and Mississippi Railway. Pop. (1880) 1,701; (1890) 1,869; (1900) 3,237; town (1900) 260.

Frenchman's Bay: an arm of the Atlantic extending 30 miles into Hancock co., Me., with a general width of some 10 miles. Mt. Desert island lies on the west side of its entrance, and Schoodic Point on the east.

French Polish: a solution of 1½ lb. of shell-lac in 1 gal. of alcohol, or 12 oz. of shell-lac, 2 oz. of elemi, 3 oz. of copal in 1 gal. of alcohol.

French Prophets: Protestant enthusiasts, who arose in France, principally after the unfortunate termination of the religious wars in the Cévennes. (See CAMISARDS.) They were originally Huguenots, and were for the most part honest, but the sufferings they had endured under persecution had exalted their minds until they believed themselves directly inspired of God. The earliest traces to be found of such enthusiasts are in Dauphiny and Vivarais as far back as 1688, but they were few in number until the opening of the eighteenth century, when they amounted to many thousands of both sexes. They believed themselves under the immediate influence of the Holy Ghost, went into trances, saw visions, and were by the populace generally treated with superstitious awe and veneration. About 1706 some of their prophets went over into England and Scotland, and rapidly gained converts on British soil. They were even joined by people of some influence. They predicted the speedy establishment of the Messiah's kingdom, and pretended to possess the gift of tongues and the power of working miracles. Their pretensions, however, brought on their overthrow. They had persisted that Dr. Eames, one of their number who had died, could be raised from the dead, and failing in this they speedily declined in influence and numbers. Their actions, however, left a stigma upon all Protestant refugees in Great Britain. See Hughson, *A Copious Account of the French and English Prophets, etc.* (London, 1814); Smedley, *Hist. Ref. Rel. in France*, iii., 253, *seq.*

French Purple: a beautiful dye obtained from lichens. See ARCHIL.

French River: the outlet of Lake Nipissing; in Ontario, Canada; flows into Georgian Bay, Lake Huron; latitude of mouth, 45° 53' N., lon. 81° 5' W. Length, 55 miles. It is a swift stream, the lower course of which looks as if it were cut artificially through the rocky walls. There are many rapids, but the stream is the channel of a considerable fur-trade, forming part of the route by which such as prefer the Ottawa to the St. Lawrence may pass from Montreal to the Red River of the North.—Another French river flows into James's Bay through the estuary of the Abbitibbe river.

French Shore: the western shore of Newfoundland, on which the French have the right to land and cure fish. This right was given by the Treaty of Utrecht (1713), and has discouraged settlements on this coast.

French Spoliation Claims: claims arising from the damages done to American ships and cargoes by the French prior to the convention between the U. S. and France, ratified July 31, 1801. When the U. S. urged these claims, which it then estimated at $20,000,000, France retorted with a counterclaim many times as great for damages resulting from the failure of the U. S. to keep its treaty obligations to that power. The convention of 1801 was a mutual surrender of these claims, the U. S. thus becoming responsible to its citizens for their indemnification. The matter came up repeatedly in Congress, and engaged the attention of some of the ablest statesmen and lawyers, but nothing was done till Jan. 14, 1885, when the House of Representatives passed a measure authorizing claimants to apply by petition to the court of claims, which was to examine and determine the amount and validity of claims thus presented and report the facts found by it to Congress for final action. The bill was approved by President Cleveland Jan. 20, 1885.

French Sudan: See SUDAN.

Frenchtown: borough; on Penn. R. R.; Hunterdon co., N. J. (for location of county, see map of New Jersey, ref. 3–C); beautifully situated on the Delaware river; 32 miles N. W. of Trenton. It has 4 churches, a sash and blind factory, 2 chair-factories, a sawmill, a manufactory of regalia, and a flouring-mill. The principal manufacture, however, is that of spokes and wheels. Pop. (1880) 1,039; (1890) 1,023; (1900) 1,020. EDITOR OF "HUNTERDON INDEPENDENT."

French War IN NORTH AMERICA, known also as the **French and Indian War** and the **Old French War**: the conflict between the English and the French in North America 1755–63. Through the able management of the Marquis of Montcalm the influence of the French was constantly extending its sphere until their line of forts in the Ohio valley, on the Mississippi, on Lake Champlain, and in the region of the Great Lakes threatened to confine the Anglo-American colonists to the strip along the Atlantic coast. The Ohio valley was claimed by both English and French, neither of whom, however, had planted any settlements there, though a few English settlers had penetrated into the valley of the Monongahela. In the latter region occurred the first important engagement. Here Gen. Braddock, in command of a body of English and colonial troops, was defeated and killed in 1755 by a combined force of French and Indians, the latter having been won to the French side in the war by Montcalm's shrewd policy. In the following year England definitely ranged herself with the enemies of France by her alliance with Prussia, and then followed the SEVEN YEARS' WAR (*q. v.*), of which the war in America became a part. In 1756 and 1757 Montcalm was successful, gaining possession of many important strategic points, but with the accession to power of the elder Pitt in England the character of the war changed. Fort Duquesne fell into the hands of the English, who destroyed Fort Frontenac, on Lake Ontario, and possessed themselves of Fort Niagara, Crown Point, and Ticonderoga, driving the French into Canada. The conquest of Canada was next attempted. MAJ.-GEN. WOLFE (*q. v.*) commanded the expedition against Quebec, which resulted in the surrender of the city in 1759, and in the following year the English were in full possession of Canada, which was formally ceded to England by the Peace of Paris in 1763. France, having sold Louisiana to Spain in 1762, ceased to have a share in the colonial interests of North America.
F. M. COLBY.

Freneau, frĕĕ'nō', PHILIP: poet; b. of Huguenot ancestry in New York, Jan. 2, 1752; graduated at Princeton, N. J., in 1771, and while there was the associate of James Madison. He went upon several mercantile voyages to the West Indies, in one of which he was taken prisoner by the British, and suffered much during his consequent imprisonment, as related in his poem *The British Prison-ship* (1781). During the Revolution he produced much prose and verse, chiefly of a burlesque character, which afforded a very effective support to the patriotic cause. He was editor of the *Daily Advertiser*, New York, 1791, and of the *National Gazette* of Philadelphia, 1791–93, and translating clerk for Mr. Jefferson, then Secretary of State. Freneau was a violent Anti-Federalist; edited in 1795 the *Jersey Chronicle*, and in 1797 the *Time Piece*, New York, after which he again became a shipmaster. He published four volumes of poetry and several collections of letters and miscellanies. D. near Freehold, N. J., Dec. 18, 1832. Some of his poems have very considerable merit. Revised by H. A. BEERS.

Frenta'ni: an ancient race of Central Italy, Samnite in blood, but not in name, for they were the allies of Rome in the Samnite wars; lived in a fertile hilly region bounded E. by the Adriatic and S. by the river Tifernus. Long the allies of Rome, they joined (B. C. 90) in the Social war, and probably were enfranchised with the other Italians.

Frère, frār, CHARLES THÉODORE: genre and landscape painter; b. in Paris, June 24, 1815. Pupil of J. Cogniet and Roqueplan; brother of P. Édouard Frère; second-class medal, Salon, 1848, and medal, Salon, 1865. His pictures generally depict Oriental subjects. *Arab Caravansary Resting*. Nancy Museum. W. A. C.

Frere, freer, Sir HENRY BARTLE EDWARD, K. C. B., G. C. S. I., D. C. L.: diplomatist; b. Mar. 29, 1815: educated at the India College, Haileybury; entered the Bengal civil service 1833; became British resident in Scinde 1856; served with distinction during the Indian mutiny; was governor of Bombay 1862–67; sworn a member of the privy council 1873; president of the Royal Geographical Society 1873–74; negotiated the treaty of 1873 with Zanzibar; governor of Cape Colony 1877–80, during Kaffir and Zulu wars. D. at Wimbledon, May 29, 1884.

Frere, JOHN HOOKHAM: diplomatist and author; b. in London, May 21, 1769; educated at Eton and Caius College, Cambridge, where he took his master's degree in 1795; at once entered the Foreign Office; was in Parliament 1796–1802; Under-Secretary of State for Foreign Affairs 1799; became envoy to Portugal 1800; envoy to Spain 1802–04; privy councilor 1804; minister to Spain 1808–09; married the Countess of Erroll 1812; removed to Malta 1821. D. at the Pietà, Malta, Jan. 7, 1846. He was a poet of much merit, and one of the founders of the *Quarterly Review*; author of *King Arthur and his Round Table* (1817, under the pseudonym of "Whistlecraft"); published *Translations of Several Plays of Aristophanes* (1840), one of the best translations of a classical author in the English language; *Theognis Restitutus* (1842); and other writings. See his *Works*, with memoir (1874). Revised by A. GUDEMAN.

Frère, frār, PIERRE ÉDOUARD: genre-painter; b. in Paris, Jan. 10, 1819. Pupil of Paul Delaroche; third-class medals, Salon, 1852, and Paris Exposition, 1855; second-class, Salon, 1852; Legion of Honor 1855. His pictures are somewhat anecdotal in sentiment, but are well painted. He had many pupils and followers at his home in Écouen, and his works are popular on both sides of the Atlantic. Three pictures are in the collection of W. T. Walters, Baltimore; *Exercise* is in the collection of J. J. Astor, New York city. D. at Écouen, France, May 28, 1886. W. A. C.

Frère-Orban, -ōr'bāān', HUBERT JOSEPH WALTHER: Belgian statesman; b. in Liège, Apr. 24, 1812; admitted to the bar 1832. He was a liberal member of the lower house 1847; Minister of Public Works 1847, and in the same year Minister of Finance; began the reform of the corn-laws in Belgium before Sir Robert Peel completed that reform in England; was for the second time Minister of Finance 1848–52, and again 1861–68; head of the cabinet, with the portfolio of Foreign Affairs, 1878–84. His administrations were noted for the increase of state income, the erection of great public buildings, reform of the school system, etc. He was a leader of the liberals. D. in Brussels, Jan. 2, 1896.

Frerichs, frā'richs, FRIEDRICH THEODOR, M. D.: physician; b. at Aurich, Hanover, Mar. 24, 1819; graduated at Göttingen and studied at the leading European capitals; became an exceedingly popular medical lecturer at Göttingen; went in 1851 to Kiel and assumed charge of the hospital; became in 1852 Professor of Pathology and Therapeutics at Breslau and director of the School of Clinical Medicine. He afterward removed to Berlin. His most valuable work is a *Practical Treatise on Diseases of the Liver*, which has been translated into English and French. D. Mar. 14, 1885.

Fréron, frā'rōn', ÉLIE CATHERINE: author; b. at Quimper, France, in 1718; was educated at the Collège Louis-le-Grand, Paris; left the Jesuits, among whom he was a professor, in 1739, for some unknown cause, but still wore the garb of a cleric. Disappointed of a benefice, he entered upon the life of a journalist. His periodical, *Lettres de Mme. la Comtesse de* ——— (1746–49), was suppressed, and soon reappeared as *Lettres sur quelques écrits du temps* (1749–54). His *Année Littéraire* (1754–76) was finally suppressed by his enemies, and he died of chagrin Mar. 10, 1776. He is remembered for his lifelong hostility to Voltaire and the Encyclopédistes, who fully returned his hatred; for his zealous championship of ecclesiastical and monarchical ideas; and as one of the founders of journalistic criticism. His works are mostly criticisms, poems, translations, and papers on subjects of no permanent interest; author of *Histoire de Marie Stuart* (1742) and *Histoire de l'empire d'Allemagne* (1771).—His son, LOUIS STANISLAS (1765–1802), is remembered as a bloodthirsty Jacobin, who became an equally cruel reactionist. He published in 1796 *Mémoires historiques sur la réaction royale et sur les malheurs du Midi*.

Fresco, or **Fresco-painting** [*fresco* is from Ital. *fresco*, adj., fresh, cool, from O. H. Germ. **fresc*, *frisc* (> Mod. Germ. *frisch*, fresh): O. Eng. *fersc*, *fresc* > Eng. *fresh*]: a term somewhat vaguely applied to different methods of mural decoration in colors or in *chiaroscuro*, but which, strictly speaking, belongs only to paintings executed on fresh or moistened plaster. In the so-called *buon fresco*, or true *fresco*, mineral colors, mixed with water or lime-water, are applied directly to the smooth wet face of good lime mortar—the last very thin layer, called the *intonaco*, being of a particularly fine quality—in which case a new chemical combination takes place, and a crystalline surface almost impervious to moisture is formed. The practice of staining walls with colors in this way may be traced even to Egypt and Greece, but it is somewhat doubtful whether it was ever applied to works of high art till toward the end of the fourteenth century. The earliest specimens of *buon fresco* are probably those of Pietro d'Orvieto (continued by Benozzo Gozzoli) in the Campo Santo at Pisa, although Förster credits the evidence that Altichiero and Avanzo had employed this process earlier at Padua. Albert Ilg, in the notes to his translation of Cennini, declares that *buon fresco* was practiced even in the Roman period, and has been practiced occasionally ever since; that it was known in Byzantium; and that the art has been handed down traditionally in the convents of Mt. Athos. However this may be, the works of Giotto and his contemporaries, though always spoken of as frescoes, were not executed in this way. The usual method of painting on plastered walls, in his time, was to allow the plaster to dry thoroughly and then to rewet such portions of it as the artist could cover with color at a single sitting. This is called by later Italians *fresco secco*, or dry fresco. Many suppose that the old Roman frescoes were generally executed in this way, but there is much difference of opinion on the subject. Some of them are certainly in *tempera*, and others in *encaustic*. (For further information as to the methods employed in producing the frescoes of Pompeii and Herculaneum, and for interesting chemical experiments upon these frescoes, see Overbeck's *Pompeii* (second revised ed., 1866), vol. i., ch. iii.) After the beginning of the fifteenth century *buon fresco*, or painting on undried plaster, became the favorite art of the greatest Italian masters, and Masaccio, Mantegna, Demonias, Ghirlandajo, Francia, Perugino, Luini, Fra Bartolommeo, Raphael, Michaelangelo, and Correggio all gloried in it and became glorious through it. The swiftness of execution required by the rapid drying of the mortar, the impossibility of correcting a mistake without removing a portion of the plaster, the vast spaces to be filled, at once demanded and permitted the exercise of the highest artistic faculties; and Michaelangelo went so far as to declare oil-painting to be work for only women and children. One obvious advantage of fresco over oil painting is that from the absence of all gloss of surface the picture may be seen equally well from every point of view; another is its greater durability under the same exposure. The subject to be represented on the wall was first drawn and shaded on paper backed with cloth; this cartoon, as it was called, or a tracing from a portion of it, was then applied to the wall, the outlines were carefully pricked through into the wet plaster and a fine black powder being blown or sifted into the perforated lines, a distinct drawing was left behind. Old cartoons pierced in this way are still extant, and the black dots can be detected in the outlines of many a beautiful old fresco. Careful inspection will also frequently show where the work of one day is joined to that of another, for the mason was obliged to lay the plaster from day to day as the artist covered it. A large proportion of the finest pictures in Italy are frescoes. Those of Giotto may perhaps be best studied at Assisi and Padua—those of Fra Angelico at Florence and Orvieto. The SS. Annunziata at Florence possesses some of Andrea del Sarto's best frescoes—the exquisite Madonna del Sacco and a series of scenes from the life of Philippo Benizzi. The Camera of San Paolo at Parma contains surpassingly beautiful frescoes by Correggio, not to speak of the domes of San Giovanni and of the cathedral, once miracles of this art by the same hand, but now well-nigh ruined by rain and dampness. The Sistine Chapel at Rome is considered by many as Michaelangelo's crowning work, and the Stanze of Raphael, also in the Vatican, are counted among the noblest efforts of that splendid genius.

The objection against frescoes, that they are not movable, is a serious one, but where time can be allowed for the tedious process they may be transferred from the wall to cloth, much in the same way as oil-pictures are removed from wood or from one canvas to another. Small frescoes in exposed places are frequently sawed out of the wall with a sufficient thickness of the plaster to keep them from falling in pieces, and so preserved. This art, though so eminently suited to brilliant architectural decoration, declined after the age of the great masters, and the only modern Italian painters who have acquired even a moderate reputation for fresco are Benvenuti, Appiani, and Cammuccini. (See Kugler's *Handbook of Painting.*) In Germany, however, *fresco secco* has been revived in a novel form through the invention, by Prof. von Fuchs, of a solution of silica called water-glass. Repeated applications of this solution are made to the surface of the best well-dried common mortar, after which it is again allowed to dry thoroughly. The whole surface is then rubbed and polished; after this it is twice rewashed with the water-glass, and once more left to dry completely. Mineral colors, prepared in water, are then applied for the decoration, and the artist can correct or change as freely as if working in oils and on canvas. When the whole is finished the entire surface is carefully sprinkled over with the solution, after which the painting is believed to be secure against atmospheric influences. This kind of fresco is called *stereochrome*, and may be seen in its highest perfection in Munich and Berlin, where Kaulbach, Overbeck, Cornelius, Schnorr, and other great German artists have exerted their best powers. Attempts at fresco-painting in Great Britain and the U. S. (as, for example, in the Parliament House in London and the Capitol at Washington) have been less successful; the same must be said of recent mural painting in France. See Overbeck's *Pompeii* (Leipzig, 1866); also translations by Albert Ilg, of *Cennino Cennini* and *Heraclius*, Nos. 1 and 4 in the series; *Quellenschriften für Kunstgeschichte* (Vienna, 1871–73); also Frederic Crowninshield, *Mural Painting* (Boston, 1887).

Fresenius, frā-zā'ni-oos, Karl Remigius: chemist; b. at Frankfort-on-the-Main, Dec. 28, 1818; studied at Bonn and Giessen, and became Liebig's assistant; entered in 1845 upon a chemical professorship at Wiesbaden; founded the *Zeitschrift für analytische Chemie* in 1862 at Brunswick; author of *Anleitung zur qualitativen Analyse* (1841) and *Anleitung zur quantitaven Analyse* (1846), both works of great value, besides treatises on the various German mineral waters, etc. His principal works are translated into many European languages, and have gone through many editions in Germany. D. in Wiesbaden, June 11. 1897.

Fresnel, frā'nel', Augustin Jean, F. R. S.: physicist and inventor; b. at Broglie, Eure, France, May 10, 1788; was educated at Caen and at the École Polytechnique and the École des Ponts et Chaussées, Paris. He was a Government engineer for eight years in the Vendée, and as a pronounced royalist was placed, during the Hundred Days, under the surveillance of the police. He returned in 1815 to Paris, and his researches on the aberration, diffraction, and polarization of light at once placed him in the front rank of physicists. In 1819 he was appointed, with Arago and Mathieu, as one of the lighthouse commissioners of France; in the same year he gained the prize of the Academy of Sciences for a memoir on the diffraction of light—a work which was crowned in 1819. In 1823 he was unanimously chosen to the Academy. In 1824 he was made secretary of the lighthouse commission, and in the same year his health, always feeble, gave way and he never again was able to work. D. at Ville d'Avray, near Paris, July 14, 1827, and on his deathbed received the Rumford medal of the Royal Society, London.

Fresnel's great life-work was compressed into five years (1819–24). That work, for which commerce, and indeed the whole human race, owes him a debt of gratitude, was the perfecting of the dioptric system of illumination for lighthouses. His system has received comparatively few improvements, and is almost universally employed in lighthouses. See *Lighthouse Illumination* under Lighthouse.

Fresnillo: a city of the state of Zacatecas, Mexico; on the Mexican Central Railroad; 36 miles N. N. W. of Zacatecas city (see map of Mexico, ref. 5–F). It is in a valley surrounded by rugged hills, in which are located some of the richest silver mines of Mexico. The city is well laid out and substantially built, but with little attempt at architectural display. Fresnillo owes its existence to the mines, which were discovered by Francisco Ibarra in 1554. Pop. (1889) 15,000. H. H. S.

Fres'no: city; capital of Fresno co., Cal. (for location of county, see map of California, ref. 9–E); situated on the Southern Pacific Railway; 206 miles S. E. of San Francisco. It is the center of an agricultural district chiefly engaged in sheep-raising, fruit-growing, and the production of wine and raisins. It ships large quantities of wheat and raisins, and has a street railway, gas and electric lights, and an excellent system of water-works and sewers. Pop. (1880) 1,112; (1890) 10,818; (1900) 12,470. Editor of "Expositor."

Freund, froint, Hermann Ernst: Danish sculptor; b. near Bremen, Oct. 15, 1786. In 1793 he was sent to a relative in Copenhagen to continue his apprenticeship as a blacksmith. In the meantime he gave his attention to drawing and modeling, and in 1805 he entered the Art Academy, where he won four medals, and with the large gold medal he also received the usual allowance for a several years' residence abroad. Before starting for Rome in 1817 he exhibited a life-size statue of *Eurydice*. In Rome, where he enjoyed the friendship of Thorwaldsen, he produced a statue of the evangelist *Luke* and a *Mercury*. In 1821 a literary society in Copenhagen published an appeal to Danish sculptors requesting them to render Scandinavian subjects, and rewards were offered for the best productions. Freund exhibited a relief of *Mimer and Balder Consulting the Norns* and some drawings of an *Odin*, and took the premiums. From that time he devoted himself with all his energy to Scandinavian mythology, and in 1827 he produced the celebrated Ragnarok frieze for the Christiansborg Palace. This frieze was partially destroyed by the great fire of 1884, but has since been restored by the Norwegian sculptor Stefan Sinding. D. June 30, 1840. There is a splendid illustrated biography of Freund, written by his son Victor, and edited by H. B. Baumann (Copenhagen, 1883).—Freund's nephew, Georg Christian Freund, b. in Altona, Feb. 7, 1821, is a Danish sculptor of rank, possessing a special talent for representing women and children. His *Little Girl Feeding a Cat* has often been reproduced, and is deservedly popular. Rasmus B. Anderson.

Freund, Wilhelm, Ph. D.: lexicographer; b. of Jewish parents at Kempen, Prussia, Jan. 27, 1806; studied at Breslau and Berlin; has been an instructor in Breslau, Berlin, Hirschberg, London, and Gleiwitz; author of *Wörterbuch der lateinischen Sprache* (4 vols., 1834–45), the basis of Andrews's, William Smith's, and Harpers's Latin dictionaries and of the larger work of Riddle and White; also author of two smaller Latin dictionaries; issued, under the title *Freund's Schüler-Bibliothek*, a series of annotations to the Greek and Latin authors usually read in the German gymnasia.

Frey, frī, or **Freyr**, frīr: in Scandinavian mythology, the brother of Freya and the son of Njörd. He is beloved of all gods and men, and is himself the god of pleasure and fruitfulness. To him Loki gave the ship Skidbladnir, which always had a fair wind, and which, though capacious enough for all the gods, could be folded up and carried in the pocket. He also gave him the swift, golden-bristled boar Gullinbursti, which could traverse air, sea, or land. He is the husband of Gerda, the beautiful daughter of the giant Gymir, for whose love he forfeited his good sword, which the gods sorely needed for their defense. He was especially worshiped in ancient Sweden. See Scandinavian Mythology.

Freya, frī'a, or **Frey'ja** (the beloved): the Scandinavian Venus, called also Vanadis, daughter of Njörd, the air-god, and wife of the god Odur, for whom she perpetually weeps tears of gold. Half the heroes who die in battle belong to her, doubtless because of old the passion of love was so fruitful a cause of wars. Friday (*dies Veneris*) is Freya's day, or, as others say, Frigga's day. See Frigg.

Freycinet, frā'sē'nā', Charles Louis de Saulces, de: civil engineer, inspector-general of mines, member of the Institute, Minister of War of France; b. at Foix, France, Nov. 14, 1828; educated at the Polytechnic School and the

School of Mines; in 1852 engineer of mines of Mont-de-Marsan, at Chartres in 1854, Bordeaux in 1855. In the latter year he was made general manager of the Southern system of railways. He held this position five years, during which time he gave to the service an organization which was imitated by all the other railways of France. From 1862 to 1870 he was sent on several scientific missions, and presented many memoirs to the Academy, including one upon the labor of women and children in factories in Great Britain. In 1870 he was member of the council of Tarn-et-Garonne, and later chief of the military cabinet of Gambetta at Tours. In 1876 elected senator, and in 1877 made Minister of Public Works. This position he retained until 1879, and then became Minister of Foreign Affairs and president of the council, a position which he resigned in 1880. Two years later he was again Minister of Foreign Affairs and president of the council, and has been in the cabinet almost continuously since that time. He was made chief engineer of mines in 1875, and inspector-general in 1883. Officer of the Legion of Honor since 1870. He was made member *libre* of the Academy of Sciences in 1882. Upon the death of Bussy he was invited to become a candidate for the vacancy in the Institute. Nearly all the other candidates withdrew, and he was elected in 1890 and received in 1891. He has written *La Guerre en Province pendant la Siège de Paris* (Paris, 1871), *Principes de l'assainissement des Villes* (1870), etc. W. R. H.

Freytag, frī'ta*k*h, Gustav, Ph. D.: author; b. at Kreuzberg, Prussian Silesia, July 13, 1816; studied at Berlin and Breslau; produced successful plays, tales, and poems; was editor of the Leipzig *Grenzboten* (1848–70); held for some years a court position at Gotha; and from 1879 lived in Wiesbaden. D. there April 30, 1895. Of his numerous works, the best known in the U. S. are *Die Journalisten* (1853); *Soll und Haben* (Debit and Credit; 1855, 37th ed. 1891), of which there are several English translations; *Bilder aus der deutschen Vergangenheit* (1859–67, 18th ed. 1891); and *Die Verlorene Handschrift* (1864, 20th ed. 1891), translated by Mrs. Malcolm under the title *The Lost Manuscript* (3 vols., London, 1865): *Die Ahnen* (1872–80, 6 vols.); *Gesammelte Werke* (1886–88, 22 vols.).

Friar [earlier *frier* < M. Eng. *frere*, from O. Fr. *frere* > Fr. *frère* < Lat. *frater*, brother]: a member of a monastic brotherhood, especially one who belongs to one of the mendicant orders—the Franciscans, Augustinians, Carmelites, and Dominicans. The Dominicans were called *Black* Friars, from their garments, and also *Preaching* Friars. The Franciscans were *Gray* Friars; the Carmelites at one time were called *Barred* Friars, from their striped robes, but in later times they were called *White* Friars. Monks not priests are called friars in Ireland, of whatever order; but after taking priests' orders they lose this distinctive name. The Franciscans are called *Friars Minor*, and there is a small order called *Friars Minims*. (See Minims.) *Crutched* Friars were canons regular of the Holy Cross.

Friar-bird: a local name given to an Australian bird (*Tropidorhynchus corniculatus*) on account of its bare head and neck. Known also as the monk, leather-head, poor soldier, and four o'clock. F. A. L.

Frias, Tomás: statesman; b. in Potosí, Bolivia, Jan. 14, 1805. He entered political life in 1828, held various important diplomatic positions, and was Secretary of State under Velasco (1840). José Ballivian (1841–46), Linares (1858–60), and Morales (1871). After the assassination of Morales (Nov. 25, 1872) he was president *ad interim* until the accession of Adolfo Ballivian in May, 1873, when he was made vice-president. By the death of Ballivian, Feb. 14, 1874, Frias became president, holding the office until 1877. His administration was peaceful and progressive. In 1879 he was minister to France. Frias was one of the greatest statesmen his country has produced, and he has been called the Bolivian Washington. D. in La Paz, Aug., 1884.
Herbert H. Smith.

Frich, frich, Joachim Gyldenkrantz: Norwegian painter; b. in Bergen, July 24, 1810. In 1850 he produced six paintings for Oscarshal in Christiania, and at the National Gallery he is represented by several Norwegian landscapes. He was a pupil of the Norwegian Dahl and the German Rottmann. D. in Christiania, Jan. 29, 1858. R. B. A.

Fricke, Gustav Adolf, D. D.: Lutheran theologian; b. at Leipzig, Aug. 23, 1822; became extraordinary Professor of Theology there 1849; ordinary professor at Kiel 1851, at Leipzig 1867.

Friction [viâ Fr. from Lat. *fric'tio*, rubbing, deriv. of *frica're, fric'tum*, rub]: that force, always acting as a resistance, which is experienced when it is attempted to move one body upon another which is pressed into close contact with it.* Friction is generally supposed to be due to the interlocking of the asperities of the two surfaces, and to abrasion by tearing them off. Friction is of two kinds—sliding friction, which is encountered when one body is forced to slide upon another; and rolling friction, which is that resistance which is met with when it is attempted to cause one body to roll upon another. The friction of a sled upon the ground or of a sleigh upon snow illustrates the first kind. The resistance of a carriage or of a railroad train consists principally of the rolling friction of the wheels upon the road or upon the track, and of the sliding friction of the wheels with their axles. When two bodies are at rest and in contact it requires more force to get up relative motion than to overcome friction after that motion has commenced. The "friction of rest" or "friction of quiescence" is greater than the "friction of motion." This difference is most marked with comparatively soft materials and with great pressures. A slight jar will usually reduce the friction of quiescence of hard smooth surfaces to that of motion.

In order to determine the real expenditure of power in doing work, and to ascertain the efficiency of machines, it is necessary to learn the amount of frictional resistance to be encountered, and to estimate the quantity of work which may be expected to be absorbed by it in each case. It is this force which has most effect in reducing the efficiency of mechanical combinations, and the losses from this cause alone are frequently very serious, amounting to 25 or even 50 per cent.†

The investigation of the laws of friction and the determination of the "coefficient of friction" have employed many of the most distinguished philosophers and engineers. The earliest extended researches were those of Coulomb, made during the latter half of the eighteenth century, and published in 1785.‡ They are given in full in his *Théorie des Machines simples, etc.*, 1821. The investigations of George Rennie, as published in the *Philosophical Transactions of the Royal Society*, in 1829, and those of Gen. Morin, recorded in the *Mémoires de l'Institut* for 1833, were more extended. The latter, which were made under the direction of the French Government, were long accepted as standard. Valuable and still later experiments have been made by Hirn,# by Bochet,‖ by Woodbury and Tower, and some work has been done by the writer.**

In determining the amount of frictional resistance the apparatus used is often, for slight pressures and low speeds, very simple. Fig. 1 represents one of these instruments. A plane, A B, is placed horizontally, and loaded with a weight, W. The plane is then raised at the end A until the weight begins to move.

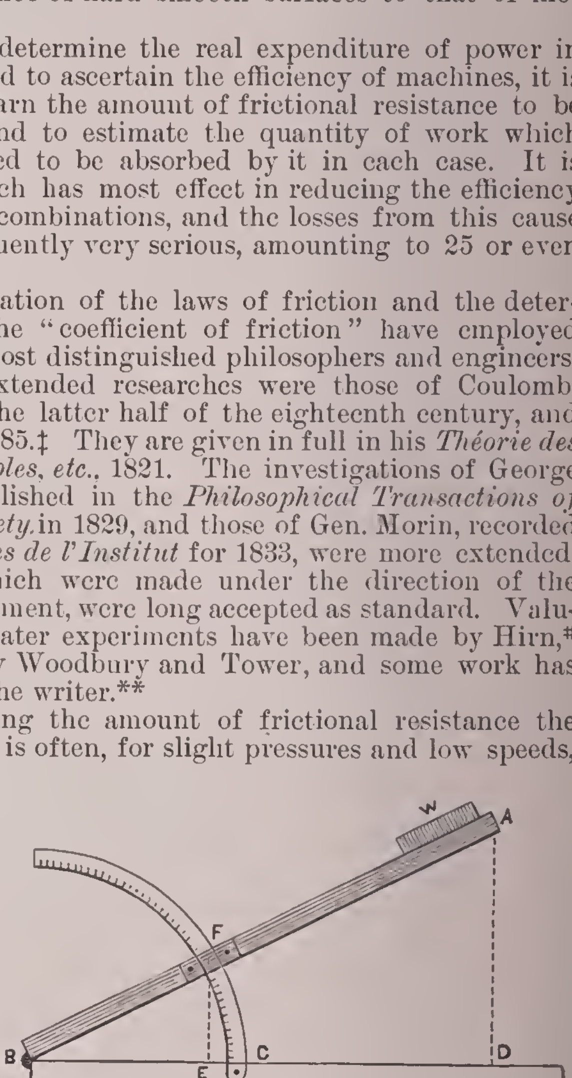


Fig. 1.

The force of friction of rest has then a ratio to that component of the force of gravity producing pressure, which is equal to the ratio of the perpendiculars A D and F E to the bases B D and B E—i. e. the "coefficient" of friction of quiescence is measured by $\frac{W \sin i}{W \cos i} = \frac{F}{P} = \tan i = f$. The angle $FBE = i$ is the "limiting angle of resistance." Similarly the "coefficient of friction of motion" is determined by noting at what angle motion will just commence, and will continue with uniform velocity after having been started by a slight jar.

The "tribometer" of Coulomb is shown in Fig. 2. A

* See treatise on *Friction and Lost Work in Machinery and Millwork*, by R. H. Thurston (New York).
† *Ibidem.*
‡ Young's *Natural Philosophy*, vol. ii.
\# *Polytechnisches Centralblatt*, 1855.
‖ *Annales des Mines*, 5me série, p. xix.
** See *Friction and Lost Work in Machinery and Millwork* for accounts of this latest work.

horizontal table, A B, is fitted at one end with a pulley, C. A block, E, slides on this table, and carries a weight, W, of any desired magnitude. The block is drawn along the surface by a suspended weight, D, which is adjusted until just

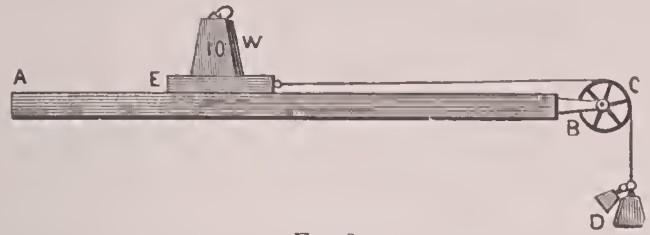


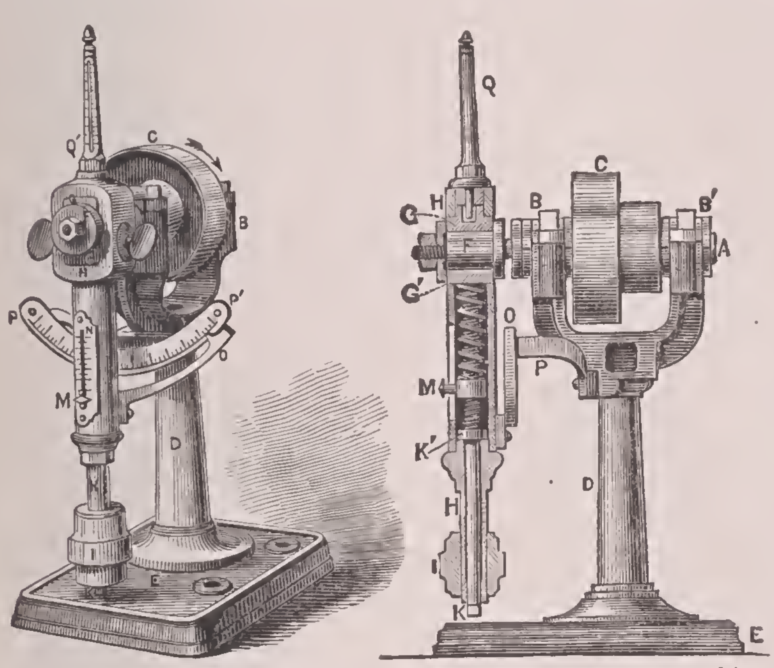
FIG. 2.

sufficient to produce or to continue motion. The nature of the rubbing surfaces and the amount of pressure upon them are readily changed, and the results obtained are quite reliable for such conditions as here obtain.

In experimental determination of rolling friction, cylinders, or rollers, of various sizes and weights are used in place of, or are placed under, the sliding block.

In ascertaining the friction of axles and of shafts revolving in their journals a shaft capable of being loaded to any required extent and driven at any required speed is used. A thermometer has sometimes been attached to indicate changes of temperature of the lubricant, or any warming of the journal due to the development of heat, into which form of energy the work done in friction is always converted. The first experiments of this character were made at the Brooklyn navy-yard by Messrs. King, Stivers, and Price, a board of U. S. naval engineers.*

A later and more complete apparatus for similar experiments is Thurston's apparatus for testing lubricants, which is shown in Figs. 3 and 4.† A shaft, A, is carried by a pair



FIGS. 3, 4.—Sectional and perspective views of Thurston's machine for testing lubricants.

of journals, B B, and is driven by a pulley, C. At the outer extremity is a third journal, F, grasped by a pair of "brasses," G G, which are caused to exert any required pressure by means of a helical spring, compressed by a screw, K K, working in the supporting nut. The degree of pressure is shown by a pointer, M, traversing the scale, N N. The arm, H, which carries this portion of the instrument is suspended so as to swing about the journal, F, and is loaded by a fixed weight, I. A pointer, O, traversing a graduated arc, P P, indicates the deviation of this loaded arm from the perpendicular, and the resulting moment equal to that exerted by the friction of the shaft in its bearing, F G. The scale, N N, bears two graduations, one of which, as just stated, indicates the pressure on the journal, while the other set of figures have such values that when the reading on the arc, P P, during any experiment is divided by the number on N N opposite that which indicates the pressure on the journal, *the quotient will be the coefficient of friction.* A thermometer, Q Q, the bulb of which is inserted in a cavity in the upper "brass" G, serves to indicate the temperature of the bearing at every instant. Thus coefficients of friction are readily determined for any kind of rubbing surfaces and for any kind of lubricant. The durability of any unguent, its capacity for resisting high temperatures or great pressures, and its general behavior under any conditions of use, may be learned. The relative values of several lubricants are ascertained with facility, testing them under the precise conditions as to pressure, velocity of rubbing, and character of surface to which it is proposed to subject them, and the kind of work to which any one of them is best adapted is indicated by the results of a series of tests under varying conditions.

By experiments made as indicated the following law has been found to exist, but only within certain limits: Frictional resistance is proportional to the force with which the rubbing surfaces are pressed together, and is independent of the extent of those surfaces and of the velocity of rubbing. The law is departed from whenever the surfaces are subjected to such intensity of pressure as to become abraded or otherwise deformed. It is also inaccurate where the surfaces are separated by an unguent, and especially when they are of such great area that the resistance due to viscosity of the lubricant becomes considerable as compared with the resistance of true friction. In this case the resistance varies approximately in proportion to the area of the surfaces in contact. This latter case occurs less frequently than the preceding. Great variations of velocity also cause a modification of the law, the friction becoming slightly less with high speeds.

The resistance due to friction is obtained by multiplying the pressure borne by the surfaces in a direction perpendicular to their planes by the coefficient of friction f. The following are values of f for the most frequently occurring cases, as given by Morin:

No.	Surfaces.	Unguent.	Angle i.	$f = \tan i$.
1	Wood on wood.........	None......	14° to 26½°	0·25 to 0·50
2	" " "	Soap... ..	2° to 11½°	0·04 to 0·20
3	Metal " "	None......	26½° to 31½°	0·50 to 0·60
4	" " "	Water.....	15° to 20°	0·25 to 0·35
5	" " "	Soap......	11½°	0·20
6	Leather on metal......	None......	29½°	0·56
7	" " "	Greased...	13°	0·23
8	" " "	Water.....	20°	0·36
9	" " "	Oil........	8½°	0·15
10	Smoothest and best lubricated surfaces....	....	1¾° to 2°	0·03 to 0·036

The value of f for earth varies from 0·25 for wet clay to 1·10 for gravelly soil; a usual value is 0·50. The coefficient of quiescence very commonly exceeds that of motion about 40 per cent.

The maximum pressure which the more frequently used unguents will bear varies with the speed of the rubbing surfaces, the liability to heat being measured by the product of pressure into velocity—i. e. by the quantity of energy expended in a given time. At a uniform speed of 200 feet per minute, the maximum per square inch, as determined by experiments on new iron shafts, running in loaded bearings, is as follows, when the elevation of temperature of bearing is not above 50° F.:

Winter sperm oil...........	65 lb.	Best mineral oil............	65 lb.
Summer " "	75 "	Light " "	55 "
Winter lard................	55 "	Lightest " "	30 "

At lower speeds and with very hard and smooth surfaces much higher pressures may be allowed. Steel crank-pins for steam-engines are sometimes subjected to a pressure of 1,200 lb. or more per square inch, with a velocity of rubbing of about 50 feet per minute; but this should be regarded as a maximum pressure, and should not be approached when possible to avoid it. Sperm oil, lard oil, and lard or tallow are the best lubricants for use on heavy machinery, either by themselves or dissolved in mineral oils. Lubricants having less "body" are more suitable for light machinery. All of the fixed animal, mineral, and vegetable oils are frequently employed, and plumbago and soapstone are sometimes used.

The temperature at which oils lose their fluidity has some influence upon their value in special cases. Winter lard oil begins to thicken at 40° F., and congeals at 25°. Winter sperm thickens at 48°, and becomes solid at 36°. Summer sperm oil thickens at 66°, and freezes at 56°. Heavy mineral oil thickens at 43°, and solidifies at 20°. Light petroleum thickens at 34°, and freezes at 18°. Very light mineral oil thickens at 18°, but remains liquid at 0° F.

Since both pressure and velocity of motion have an influ-

* *Friction and Lost Work in Machinery and Millwork.*
† *Ibidem.*

ence in determining the value of a lubricant, that which is best adapted for any special case should always be selected after trial under the precise conditions of actual use, both of speed and pressure, whenever possible.

Work lost in overcoming friction gives rise to heat to the amount of one British thermal unit for each 772 or 778 foot-pounds so expended. Where this evolution of heat does not produce overheating of the bearing surface or burning of the unguent, it does no harm. The amount of pressure thrown upon the surfaces exposed to friction should always be carefully kept far below the limit at which heating is liable to occur at the proposed velocity of rubbing.

The diameter of the journal of a revolving shaft is fixed by the consideration of the stress which it has to bear; its length is determined by the magnitude of frictional resistances and the limit of pressure admissible. The following formula was first proposed by the writer in 1862, from observation of and experiment upon the crank-shafts of naval steamers:

$$P=\frac{60{,}000ld}{V},\ \text{or}\ l=\frac{PV}{60{,}000d}. \qquad (1)$$

Rankine in 1865 published the following, as derived from locomotive practice:

$$p=\frac{44{,}800}{60\,V+20}. \qquad (2)$$

In these formulas l represents the minimum length of bearing in inches; d is its diameter, V the velocity of rubbing in feet per minute; p the maximum pressure per square inch of longitudinal section of the bearing, and P the maximum total load on the journal in pounds. Mr. J. D. Van Buren published in 1869 the formula deducible from (1):

$$l=\frac{PN}{350{,}000}, \qquad (3)$$

where P is the total working load on the bearing of a crank-pin in pounds, and N the number of revolutions per minute. Mr. T. Skeel in 1873 gave the following:

$$l=\frac{IHP}{130s}\ \text{to}\ \frac{IHP}{150s} \qquad (4)$$

in which IHP represents the "indicated horse-power" transmitted by the crank-pin, and s is the stroke of piston in inches. All of these formulas will be found useful for plane as well as cylindrical surfaces. These several formulas give different results, but those giving smallest journals represent a limit of safe working; those giving largest bearing surfaces exhibit proportions for safe and conservative practice.

Good practice is generally considered to dictate a limit of pressure as low as 800 lb. per square inch for other metals than steel. With thorough lubrication, which should always be carefully provided, and pressures below the maximum, the kind of metal of which the bearing surfaces are composed does not usually affect, in any appreciable degree, the amount of frictional resistance.

In general, to reduce the amount of power lost in friction, parts should be made as light as possible consistently with proper strength; rubbing surfaces should be given as great an area as possible; the velocity of rubbing and distances moved over should be kept well below the maximum due the pressure; and lubricants should be carefully chosen, and should be supplied to the journals, if practicable, in streams, and collected and filtered for use over and over again. A free supply is the only secret of the remarkably low friction sometimes observed. A common length of journal for shafting, as made by the best builders, is five times the diameter. With ample surface and effective lubrication, wear becomes imperceptible. Heavy weights are often carried on rollers, and wagons and carriages are mounted on wheels, rolling friction being thus substituted for the more serious form of sliding friction. "Friction-wheels" supporting the shafts of grindstones, or as applied in the "Atwood machine," also illustrate this case.

Although, in the operation of machinery and in many other instances, friction is an annoyance and the cause of even very serious losses, it is also frequently very useful. The friction of the driving-wheels of the locomotive upon the track is essential to the useful application of its power. "Friction-gearing," driving by the friction produced by contact and mutual pressures of smooth peripheries, has now many important applications. Nails, screws, and wedges would have no value except for the frictional resistance which retains them in place when once "driven home." The checking of the recoil of ordnance and of the motion of railroad trains is accomplished by "friction-brakes." Even the act of walking becomes impossible when, as upon smooth ice, the foot finds no frictional resistance to its movements.

Rolling friction has been found to be governed by a law which is expressed with approximate accuracy by the formula given by Coulomb,

$$F=f\frac{R}{r}, \qquad (5)$$

in which F represents the resistance, or the required force of traction to overcome it, when R is the load expressed in similar units of force, and r is the radius of the roller on which the load is carried. The coefficient of friction as determined by experiment is represented by f. The experiments of Gen. Morin confirm the deductions of Coulomb, while those of Dupuit and those of Poirée and Sauvage give results in which F varies nearly as the square root of r. The formula above given is generally adopted. Coulomb found the value of f for rollers of elm to be 0·032; Weisbach and De Pambour found the value for railroad car-wheels to be very closely 0·02. The total resistance of railroad trains on level grades and under favorable conditions is usually from 8 to 10 lb. per ton weight of train at all ordinary speeds. For vehicles mounted on wheels the tractive force is $2F$, since the impelling force is applied at the axis and its lever-arm has but one-half the length assumed in the formula. The value of f is subject to great modifications with different surfaces, and by the effect of the load in altering the form of the wheel or the roller, and in indenting and compressing the surface on which it moves.

The frictional resistance of *pulleys* arises in a great degree from the rigidity of their cordage. This was found by Coulomb to be proportional to the tension, to increase nearly as the square root of the cube of the diameter of the rope, and to be inversely proportional to the diameter of the sheaves over which the rope passes or of the cylinder around which the rope winds. Weisbach has shown that this rigidity is due principally to the lateral friction resisting the slipping of the fibers among each other, and that it is less with greased or tarred ropes than with dry cordage; and also that wire ropes offer less of this kind of resistance than ropes of hemp.* Where a rope is wound several times around a cylinder, the resistance increases in a geometrical ratio. It is for this reason that the strongest rope may be broken by the friction produced by a few turns taken about a post, as is sometimes seen in the common practice of seamen "rendering" a line around the "bitts" in checking the motion of a vessel at the wharf.

Fluid friction, so called, is a resistance due to viscosity of the fluid, and to the resistance of the inertia of those particles which are subjected to change of motion. The resistance of well-formed vessels is caused almost entirely by "fluid-friction." The amount of this resistance is given by Rankine † at "1 lb. per square foot of surface moving ten knots" (nautical miles) "per hour." By Isherwood ‡ it is stated to be "0·45 lb. per square foot of surface moving with a velocity of 10 feet per second." This resistance varies directly as the area of surface and nearly as the square of the velocity. R. H. THURSTON.

Friday [M. Eng. *Friday* < O. Eng. *frīgedæg*, *frīgu*, love + *dæg*, day, the personified Frigu being identified with Lat. Venus. Hence *frīgedæg* is trans. of Lat. *Veneris dies* > Fr. *vendredi*, Friday]: the sixth day of the week, following Thursday and preceding Saturday. In the Eastern, Latin, and Anglican Churches all Fridays, except when Christmas falls on a Friday, are days of abstinence, in memory of the passion of our Lord, which is especially commemorated on GOOD FRIDAY (*q. v.*). In the folk-lore of many nations Friday is considered an unlucky day, doubtless on account of the religious associations connected with it.

Friedland: town of Prussia; 27 miles E. of Königsberg (see map of German Empire, ref. 1–K.) Here the allied Russians and Prussians under Bennigsen were defeated by the French under Napoleon, June 14, 1807. This reverse caused the retreat of the Russian general upon Tilsit, where the treaty known as the Treaty of Tilsit was drawn up. Pop. 2,609.

Friedland: town of Bohemia; 68 miles N. of Prague (see map of Austria-Hungary, ref. 3–D). Wallenstein,

* *Zeitschrift für Ingenieur-wesen*, vol. i., 1848; also *Friction and Lost Work in Machinery and Millwork*, chap. ii.

† *Shipbuilding*, p. 81.

‡ *Engineering Precedents*, vol. i., p. 13; see also Thurston's *Manual of the Steam-engine*, vol. ii., chap. i., art. 28.

whose castle is close by, took his title of duke from this town. Pop. (1890) 5,282.

Friedland, Valentin, surnamed Trotzendorf, from his birthplace in Upper Lusatia, Germany: educator; b. Feb. 14, 1490; studied at Leipzig, where he learned the Greek language, and in 1515 became a teacher at Görlitz. His sympathy with Luther drew him to Wittenberg in 1518, and thenceforth he enjoyed the friendship of both Luther and Melanchthon. In 1523 he was called as rector to the gymnasium at Goldberg where he remained for four years. After two years of teaching at Liegnitz and a second visit to Wittenberg, he returned in 1531 to Goldberg, where his enthusiasm and ability gave to the gymnasium a European fame. The students, who at times exceeded a thousand, were admirably drilled and organized on the model of the Roman republic into consuls, senate, censors, etc., with Friedland as the *Dictator perpetuus*. See Pinzger, *Valentin Friedland, genannt Trotzendorf* (1825), and Löschke, *Valentin Trotzendorf* (1856).

Friedländer, freet'len-der, David: Jewish scholar; b. at Königsberg, Prussia, Dec. 6, 1750; became the leader of the Jews in educational and social reforms, and proposed a union of the Jewish with the Christian Church without the Jews acknowledging the Messiah. The ecclesiastical authorities of Prussia rejected the proposal, but the literature occasioned by it is quite extensive. D. in Berlin, Dec. 25, 1834. See Jost, *Geschichte des Judenthums*, etc., iii., 316, *seq.*

Friedrich, Johannes: See the Appendix.

Friend: village; Saline co., Neb. (for location of county, see map of Nebraska, ref. 11–G); on the main line of the Bur. and Mo. Railroad; 38 miles S. W. of Lincoln; in one of the finest agricultural districts in the State. It has 5 churches, a graded high school, 2 large grain elevators, and a very fine creamery. Pop. (1880) 555; (1890) 1,347; (1900) 1,200. Editor of "Telegraph."

Friendly (or **Ton'ga) Islands**: a group of over 150 islands, forming an independent kingdom; situated in the Pacific Ocean between lat. 13° and 25° S. and lon. 172° and 177° W. The smaller ones generally are of coral formation, while the larger ones are of volcanic origin. They have few native animals, but plenty of yams, sweet potatoes, and breadfruits. Collective area, 385 sq. miles. Pop. (1890) 21,750 natives and 250 foreigners. The largest island is Tongatabu (128 sq. miles). Mariner's *Account of the Natives of the Tonga Islands* is a classic.

Friendly Societies: associations which provide for their members relief in sickness and old age, and a small sum at death. The term originally included societies for good fellowship and conviviality, and many existing societies retain traces of the purpose which their name primarily indicates. In one shape or other they have existed from very ancient times; the Chinese have had their burial clubs from time immemorial; they were known to the Greeks under the name of ἔρανοι; and one of the prominent features of the Roman trade-guilds was the provision at the cost of the whole body of members of the customary ceremonial observances at the death of one of them. On certain appointed days in each year its members met to commemorate their departed brethren.

In this simple form of burial clubs, friendly societies respond to a sentiment that has prevailed among all peoples, savage and civilized, in all times. By a kind of instinct mankind has surrounded the disposal of the dead body with an apparatus of ceremony and of lavish expenditure which is frequently in strong contrast with the circumstances in which the life of the deceased was spent. This is thought to be grateful to the feelings of the defunct, and a sort of passport to the spirit-world. These costly obsequies are frequently beyond the means of the surviving relatives, and hence the help of neighbors comes to be offered. The step of making that help a matter of definite contribution is an easy and natural one.

The English race all over the world has developed more than any other the faculty and the practice of free association. These guilds carried on the tradition of mutual assistance for many centuries. They applied it not merely to provision for burial, but to brotherly aid in many other exigencies of life. Twenty such purposes have been enumerated (Walford, p. 7). viz.: relief in poverty, sickness, old age; on loss of sight, of limb, of cattle; on fall of a house; making pilgrimages; in case of loss by fire, floods, robbery, shipwreck; in imprisonment; defending legal action; in deafness, dumbness, leprosy; providing dowries on marriage of females, or on their entering a house of religion; aid in temporary pecuniary difficulties; in obtaining work; and the repair of roads and bridges. By such means the old guilds made provision for almost all the emergencies of life; and they did it after a fashion which is still popular among trades-unions, as well as with many friendly societies, viz., by means of levies. They did not take into account any question of extra risk arising from difference of age, or seek so to apportion their contributions as to create a reserve fund, but met each demand as it arose. They succeeded, however, in accumulating, in one way or other, considerable funds and landed estates. This wealth pointed them out as an easy prey to the spoiler, and long before the Reformation the state had looked greedily on their funds. The religious or superstitious element in their observances gave the pretext for their final extinction. That extinction was virtually so complete that the line of descent from the old guild to the modern friendly society, if it exists, is not easily to be traced. The probability is that the modern friendly society is a new birth. Though it has many features in common with the old guilds, it seems likely that, speaking generally, it grew out of the needs of the people, and owed little or nothing to its predecessors. They had left hardly a tradition behind them.

Here and there are traces of societies which existed during the seventeenth century; but the substantial revival of friendly societies seems to be due in a great degree to the worthy men whom the Revocation of the Edict of Nantes drove to seek refuge in England, and who afforded priceless examples of industry, of frugality, and of providence. Like their religious societies, several of their friendly societies have survived. Some of these are commemorative of the particular place from which the refugees had to flee, as the society of Lintot, which was originally exclusively for those who had been inhabitants of that town; others were formed among the refugees generally, but all have had long and useful careers.

By these and other means the growth of friendly societies had become by 1793 sufficiently obvious to attract the attention of the British legislature, and in that year Sir George Rose succeeded in passing an act for their encouragement and protection. When this statute is looked at in the light of the strange anomalies of the legislation of that day, it will be seen how large and real were the benefits it conferred upon societies. It enabled their trustees fully to protect their funds: it exempted them from all fees to barristers and officers of the courts when they had occasion to seek legal redress; it relieved them of the heavy burden of the stamp duties; it swept away every legal formality that oppressed them. The great number of societies that availed themselves of its provisions shows how wide-spread the movement had already become, and how much the benefits of the new legislation were appreciated. In Middlesex alone nearly 1,000 societies enrolled their rules, and the proportion in other counties was almost as great. The rules adopted were simple in their construction, usually provided for an annual feast, for monthly meetings, for uniform contributions for all members, for levies on the death of a member or member's wife, and for fines and expulsion in case of misbehavior. The justices by whose authority they were enrolled appear to have thought any close scrutiny of their provisions unnecessary, and no scientific adjustment of contributions to benefits was attempted.

The cry very soon arose, that has been taken up and repeated over and over again, and is even now constantly heard, that these societies, which were to put an end to pauperism and enable the workingman to provide for his own old age, were failing to do so, and making things worse instead of better. By 1817 this cry had acquired sufficient volume to call for the appointment of a select committee and upon the report of this committee was drawn up the second organic act relating to friendly societies. It recited the evils which had been found to exist and the necessity of seeing that the contribution of members should be adequate to provide for the risk to be insured. The modern profession of an actuary had but recently been developed, and the framers of the statute relied upon the certificates of two professional actuaries or persons skilled in calculation to insure the result they desired. The justices were to be satisfied as to the qualification of the persons certifying before enrolling a society. Some few societies obtained certificates from the Morgans, the Rainbows, and other great actuaries of that early day, but the majority were launched by local calculators. In one case the justices rejected a certificate for want of qualification in the givers of it; but in general they were not strict. The village schoolmaster was a favorite certifier, as indeed he had the right to be.

Somehow this system broke down; it discouraged the enrollment of friendly societies, and at the same time did not insure the solvency of those which were enrolled, and by the year 1828 the time had arrived for a further inquiry and for a new departure. The act of the tenth year of George IV. omits all reference to the persons skilled in calculation, and allows of a legal constitution being given to friendly societies whether they can satisfy the justices that their schemes are sound or not. It substitutes for the justices as examiners of rules a barrister to be appointed for the purpose, and gives him no discretion in the matter of rates of contribution. The barrister so appointed was Mr. John Tidd Pratt, who held office for forty years, and was a man of great energy and force of character. The part taken by him in the development of friendly societies was important. He was strongly impressed with the necessity of their being established on sound principles, and with this view he circulated many thousands of copies of model rules and rates prepared by actuaries. He was ready to help all who came to him with new ideas, and fertile in suggestions for carrying them into effect. He set his face against the wastefulness of the collecting societies, which he exposed in his periodical reports to Parliament. His views had great weight with the numerous parliamentary committees appointed on the subject.

In the year 1846 his official relation to societies was altered from that of the barrister certifying their rules to that of registrar, having the custody of the rules themselves and of other legal documents relating to the societies. By subsequent legislation the powers of the registrar have been from time to time increased. The act of 1846 contemplated the requirement from every society of a valuation once in every five years of its assets and liabilities; but before a single term of five years had elapsed the act was repealed, and this very necessary requirement was not again made until 1875. It is difficult to measure the loss which the hasty repeal of the excellent enactment of 1846 has inflicted on members of societies.

The requirement of a periodical valuation marks the final stage in the evolution of the modern scientific friendly society out of the old semi-charitable guild or club. If the society is to give to each its due, to be the organ of self-respecting insurance, and not the almoner of a more or less humiliating system of charity; still more, if it is to be worked on such principles of equity that its benefits are not all to be exhausted by the earlier claimants, to the prejudice of those whose claims happen to be longer deferred, it must not only enter upon contracts that are just and equitable in their terms, but it must exercise constant watchfulness over its affairs during the currency of those contracts. What the rates of contribution are that would be just and equitable to assure a given benefit is a question not easy to answer. Large bodies of statistics have been collected and published by the Manchester Unity of Odd Fellows, the Ancient Order of Foresters, the Independent Order of Rechabites, and other bodies, and a still larger collection of facts is being digested by the actuary to the registry office, but no society can be assured beforehand that its experience will in fact correspond with that shown by any of them. The liability to sickness varies with the locality and the occupation of the members, and the claims for sick pay vary still more with the amount of vigilance exercised by the society over the claimants.

The only test by which a society can ascertain whether it is charging just and equitable rates to its members is that of the periodical valuation. Once every five years the position of the society will be measured by the standard of the rates of sickness and mortality assumed in its tables, or, better still, by that afforded by its own experience, and it will be ascertained whether it is losing ground, and to what extent, or whether it has been so fortunate or so well managed and supervised as to have accumulated a surplus. In the one case a levy should be made, or the rates of contribution increased, or the rates of benefit diminished; in the other case the benefits may be increased. Such was the intention of the act of 1846. If it had been fulfilled, societies generally would have become awake to the necessity of more careful management, and much disappointment and loss to individuals would have been averted. In another respect the act of 1846 sought to apply a remedy to a growing evil in friendly societies—that of the insurance of the lives of young children. It forbade any insurance to be effected on the life of a child under six years of age. This prohibition also was removed by the act of 1850. Probably regulation would have been better than absolute prohibition, but the free trade in children's insurance which was permitted by the act of 1850 has certainly been productive of evil.

The act of 1846 is also noteworthy as having included the frugal investment of savings among the objects for which a friendly society might be formed, and thus given occasion for the establishment of what are now known as co-operation societies, for which further special provision was made in 1852. The act of 1850, which repealed that of 1846, and omitted to re-enact some of its more important provisions, is to be remembered as having for the first time recognized the bodies now known as the affiliated orders. They had existed for many years, and had been doing good work; but the mistrust which the legislation of that time felt for societies in correspondence with one another had caused them to be treated as unlawful.

They were indeed obnoxious to two cruel penal acts which are still on the statute book, the Corresponding Societies Act and the Unlawful Assemblies Act; and this had given them the color of secret societies. Their secrets have doubtless always been as harmless as those of Freemasonry, from which indeed they seem to have been derived, but the Freemasons were specially exempted from the operation of these acts. The act of 1850 exempted friendly societies with branches from it also, and enabled them to be registered. The Ancient Order of Foresters was the first to avail itself of the benefits of registry, and was soon followed by the Manchester Unity of Odd Fellows, the Nottingham Ancient Imperial Order of Odd Fellows, and others of the leading affiliated orders.

The act of 1855 enabled the branches of these orders also to become registered as separate bodies, but it was the custom for them to set forth in their rules their relations to and dependence upon the central body of the order. The circumstance of their having a separate existence, however, raised difficult questions between them, and resulted in frequent secessions. The act of 1875 effected a great improvement in this respect. It provided for the recognition of branches as portions of the order under the control of its central body, but recognized a qualified independence by making it an essential characteristic of a branch that it should have a fund or funds administered by itself in addition to the central funds of the order.

To quote a description which has been acknowledged to be correct: "In the most highly organized orders there are three stages: the lodge, by whatever name it may be called; the district, which is an aggregation of lodges; and the order, which unites the whole. The usual arrangement was that the lodges insured sick pay, the districts death money, and the order itself insured nothing." The act of 1875, however, required that every branch should contribute to a central fund administered by the central body of the order, and submit to the control of that body. This has led to the raising, in several of the orders, of a fund for the relief of distressed lodges and districts, so as to avoid their breaking up. The progress of these affiliated orders illustrates how powerless the legislature is to restrain large numbers of the people from entering into contracts that they have learned to regard as to their own advantage. Even the highly penal laws against corresponding societies had become dead letters, so far as regards these perfectly innocent bodies, long before they were in fact repealed. Each successive act of the legislature has been a step further in the direction of recognizing the real relation between these bodies and their branches, while the judicature has emphatically laid down that the contract embodied in their rules is one that must be faithfully adhered to. Societies the very existence of which was considered contrary to the public welfare are now fully recognized.

Taking the most recent and comprehensive information that can be obtained about these bodies, there are in England and Wales belonging to the affiliated orders 16,400 registered branches, having 1,727,809 members and £12,-121,202 funds. Their annual income and expenditure have been estimated as follows: Contributions, £3,024,000; interest and other receipts, £531,000; total, £3,555,000: benefits, £2,681,000; expenses, £449,000; saved on the year, £425,000; total, £3,555,000, as before. Of these registered branches, 11,242 had made returns of their quinquennial valuations, showing in 2,281 cases an aggregate surplus of

£874,679, and in 8,961 cases an aggregate deficiency of £6,716,838. With regard to the independent societies, that is, societies not in connection with any orders, and societies which, though really in connection with some orders, have chosen to retain their separate registry under the act of 1855, and not to become fully registered branches under that of 1875, the following particulars may be given: Number of societies, 10,426; members, 2,133,710; funds, £9,289,361. Annual estimated income and expenditure: Contributions, £1,707,000; interest and other receipts, £410,000; total, £2,117,000: benefits, £1,596,000; expenses, £195,000; saved in the year, £326,000; total, £2,117,000, as before. Of these societies, 3,717 had furnished returns of their valuations, showing in 827 cases a surplus of £658,252, and in 2,890 cases a deficiency of £3,901,435.

While the successive acts from 1793 onward have extended privileges to registered societies, it has never been the policy of the legislature to prohibit the formation of societies outside of the registry acts. There is not and ought not to be anything criminal in a number of persons having a common interest assembling together and endeavoring to aid each other in making provision for the ills of life in their own way. Accordingly, many registered societies exist; how many can not be ascertained, but it was thought by friendly societies commissioners in 1874 that the field of unregistered societies was at least as large as that of the registered. Impatience with the restrictions of the friendly societies acts is a frequent cause of this.

Unwillingness to incur the expenses of valuation is another cause. This is shown by the circumstance that since 1875 the proportion of societies registered under conditions in which the valuation would be dispensed with has been much greater than it was previously. Juvenile societies and societies making a periodical division of funds, from which, as not involving any accumulation of capital to meet future risks, a valuation would not be required, form a considerable proportion of the societies applying for registry.

Other societies which are deterred from registry are those which are established in large industrial works by arrangement between employer and employed, in which the belonging to the society is made a condition of employment, and the contributions are therefore not voluntary, as the act requires. If it were safe to assume that the members of unregistered societies are equal in number to those of the registered societies, the estimate of the extent to which the British workingman has made provision for his future would be amazing. It is estimated that the number of adult male persons of the working class somewhat exceeds 7,000,000. The number of members of registered friendly societies is 3,861,519, besides a further 3,318,942 belonging to the collecting societies, presently to be referred to. Omitting these latter, as largely consisting of women and children, and as being almost exclusively for the assurance of burial money only, and striking off the odd 861,519 as representing the infant and female membership of the ordinary societies as well as the cases in which a member belongs to more than one society, the number of adult male members of registered friendly societies left is 3,000,000.

If to these be added nearly a million members of trades-unions, the majority of whom are assured for friendly society benefits, the practice of making provision for sickness and funeral expenses is spread over an area almost equal to that of the male working class population, and one would almost be justified in asserting that those who do not make such provision are a mere residuum, consisting mainly of persons not in regular employment. The man in steady employment is, it would seem, almost invariably insured to some extent in some society of one class or another.

If the provision made by friendly societies were as comprehensive as that of the old guilds before mentioned, it might be supposed that the workingman was effectually protected against every contingency of life; but that is not so. Few societies make any definite provision against inability to work through old age; but many are prevailed upon by excellent motives of sympathy with their older members to continue sick pay during the whole of life, and thus provide them with what amounts to an old age pension. This well-meant liberality is the most usual cause of the insolvency of societies; for the contributions of the members are rarely more than sufficient to provide for such casual sickness as may arise during their working lives, and the funds rapidly become exhausted when the society attempts to do more than this. On the other hand, there can be few things more deplorable than to see a man who has been an honest and thrifty workman during the active years of his life reduced to seek the workhouse as an asylum in his last days. Probably this does not happen with anything like the frequency that has been asserted, but that it should happen at all is a thing to be prevented. The minds of statesmen and philanthropists in Great Britain have been much directed to the means of preventing it. Numerous schemes of compulsory insurance, of state aid, and of free pensions have been promulgated, and a royal commission of high authority has been appointed to discuss the position of the aged poor, and devise the best means of ameliorating it.

The provident method seems to be the only one by which the problem can be solved; but not the cast-iron system of fixed annuities commencing at a given age. The question should be approached from the side of the worker's real wants, not from that of the theorist. Encourage him to lay by for old age as much as he can spare, after having met the more urgent claims of the present day; commute his savings into a pension when inability to work through old age comes upon him, whether it be early or late; impose upon him no conditions of forfeiture. At present he pays one or one and a half weeks' income to his friendly society; get him to lay aside two weeks' income, and the uncertain provision for old age which he now assures might be placed beyond doubt.

It is urged in favor of some schemes of state aid, or state provision for the aged, that the incomes received by many agricultural and other laborers are insufficient to allow of their making further provision for old age than they do at present; but those who thus argue overlook that, if it be so, state aid would be a gift to the employer and not to the workman. The only form in which state aid could, perhaps, be useful is in the safe keeping of the funds. To subsidize them in any way out of the general taxation would probably be a mischief; but the least harmful form of subsidy would be the grant of a fixed rate of interest, even if it exceeded to a slight extent the current rate paid to the public creditor. This would be a return to the legislation of 1828.

A class of friendly societies remains to be mentioned which differs widely from the others in many respects, viz., the collecting burial societies. Of these there are 39, having 3,318,942 members, an average of 85,101 to each society, the larger number being infants. Their accumulated funds were £2,289,858, or £58,714 for each society, but only 13*s.* 9*d.* per member. Their valuations, however, are favorable: 14 societies had a surplus of £248,388, and 15 societies a deficiency of £116,242. The complaints against these societies are not that they incur the risk of insolvency by charging too little, but that they are conducted on too wasteful a system, that for every shilling that goes to benefit the member another shilling is spent in management. These complaints are to a certain extent met by the observation that the contributions of the members are payable by small weekly installments, and have to be collected from them by an army of officials. These collectors have to be remunerated for their services, and the remuneration must necessarily be large in proportion to the small contributions. If the members could be induced to dispense with their services, the management of these societies would be much more economical; but the members can not be persuaded to act for themselves, or to take any real interest in the working of these societies, and it is thus that the mischief arises. In contrast to the British system, that which prevails in France may be briefly commented on. Friendly societies in France are of three classes: 1. Societies recognized as establishments of public utility; 2, approved societies; 3, authorized societies. The first two classes have many privileges. They are provided by the commune with gratuitous meeting-rooms and books of account, and are exempt from stamp duty. They are allowed 4½ per cent. interest on their funds; receive subventions from the state; and there is a triennial distribution of honors among their most deserving managers. Their members exceed 1,000,000; those of the merely authorized societies exceed 300,000. The income of the three classes of societies together for the year 1890 was £1,170,000; their capital, £6,938,000.

In like manner, in Germany, legislation having for object the universal extension of accident insurance, sickness insurance, and old age insurance, has brought the friendly societies into closer relation with the state than exists in Great Britain, or than the modes of thought of the British people are accustomed to, or disposed to tolerate. In the British colonies of Australasia, New Zealand, Ceylon, and elsewhere, as well as in the Dominion of Canada, friendly societies flourish, and are regulated by legislation based upon that of the mother-country. In these young communities the form of society which has found most favor, and has indeed been almost universally adopted, is that of the affiliated order. As embodiments of thrift and self-reliance, and training-schools in the art of self-government, the development and extension of the friendly society system among English-speaking communities is full of bright promise for the future.

Authorities.—*Friendly Societies and Guilds*, by C. Walford (reprints from his *Insurance Cyclopædia*, 1878); Hardwick's *Manual of Friendly Societies*; Pratt's *Law of Friendly Societies* (11th ed. 1888); *The Friendly Society Movement*, by Rev. J. F. Wilkinson (1886); *Mutual Thrift*, by the same (1891); *Quarterly Review* (April, 1888); *Odd Fellows' Magazine* (*passim*); *Foresters' Miscellany* (*passim*); reports on sickness and mortality in the *Manchester Unity*, by Ratcliffe, and in the *Ancient Order of Foresters* and *Independent Order of Rechabites*, by Neison; reports of chief registrar of friendly societies (1855, *et seq.*); reports of royal commission on friendly societies (1872–74); reports of parliamentary committees (1817, *et seq.*); article, *Friendly Societies*, in *Encyclopædia Britannica* (9th edition); Ansell on friendly societies; Scratchley on friendly societies; account of some remarkable friendly societies, by H. Tompkins.

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Friendship: village; Allegany co., N. Y. (for location of county, see map of New York, ref. 6–D); on railway; 22 miles N. E. of Olean. It is the seat of Baxter's Musical University, and has five churches, an academy and union school, a foundry, a sash and blind factory, and a cheese-box factory. Principal business, farming and cheese-making. Pop. (1880) 1,134; (1890) 1,369; (1900) 1,214.

Editor of "Register."

Friends of God: a body of religious persons in the fourteenth century who constituted an unorganized brotherhood. Some were laymen, like Nicholas of Basel, their greatest leader; others were monks, like Tauler, the great Dominican mystic. The Friends of God adhered to the Church, but attempted great reforms within it. They were mystics, but intent upon realizing in practical life their ideas of holiness. "He is a perfect man," says John of Chur, "who has become one with God, wanting nothing else but what God will." They were very strict in attending church service, but they gave novel and often fantastic explanations of the religious symbols; and they were unsparing in their denunciations of ecclesiastical abuses. They formed no sect, but attempts were now and then made at organizing local brotherhoods. Thus John of Chur (d. in 1380) retired from the bustle of his native city, built a chapel near the Castle of Rüttberg, in the canton of St. Gall, and was for many years the center of a wide circle of adherents. They also maintained personal and epistolary communication with one another, especially within the same locality. But something vague and obscure always remained hovering about them, their doctrines, and their relations. See Jundt, *Les Amis de Dieu au quatorzième siècle* (Paris, 1879).

Friends, Society of, commonly called **Quakers**: a sect of Christians, distinguished by their belief in the "Light Within," or the immanence of the Holy Spirit, and by a number of "testimonies" springing from that belief.

Foundation.—The revolt from authority and tradition which characterized English religious thought in the seventeenth century is primarily responsible for the rise of a sect whose members called themselves at first the Friends of Truth, and later the Society of Friends. The term Quaker has been erroneously explained on the basis of physical excitement during worship; but Fox says it was Justice Bennett at Derby in 1650 "who was the first that called us Quakers, because I bade him tremble at the word of the Lord." While, as Bancroft says, the rise of this sect "marks the moment when intellectual freedom was claimed unconditionally by the people as an inalienable birthright," and while the historian Lecky has spoken of Quaker doctrine as "that strange form of distorted rationalism," nevertheless the origin of Friends must be connected with the life and teaching of George Fox. His biography is the history of early Quakerism, yet it should be remembered that he did not seek to organize a new sect; he sought simply to proclaim a purification of the Church at large, and a revival of Christianity in its original simplicity and freedom. George Fox was born in Leicestershire, England, 1624, the son of a weaver—"righteous Christopher"—who left him a small property, sufficient for his simple needs during a life of sixty-five years. In his famous journal he has described the stormy time of his early religious experiences, and the steps by which he was led into a mission of peace to his fellows; despite the sneers of Macaulay this book is now regarded as the sincere and eloquent utterance of a profoundly spiritual nature. Humility and power of will have seldom been so remarkably united as in George Fox. A certain dignity and force of character, preserved through manifold imprisonments and persecutions, led the civil authorities to regard him with respect; he was not free from the hysteric and extravagant taint which we meet in nearly all the religious men of his day, but integrity, simplicity of life and conversation, great executive and organizing power, and a certain readiness in all emergencies—"I never saw him," says Penn, "not a match for every service or occasion"—combined to make him a trusted leader of men. The central point of his doctrine is the direct responsibility of each soul to God, without mediation of priest or form, because of the presence of the Holy Spirit in the heart of every human being. "The Lord God opened to me," he says, "by his invisible power how every man was enlightened by the divine light of Christ: I saw it shine through all, and that they who believed in it came out of condemnation into the light of life, and became children of the light; but that they that hated it and did not believe it were condemned by it, though they made a profession of Christ . . ." From this central article of belief radiate the distinguishing doctrines of the society. Because all men share in this light, the Quaker insisted upon tolerance, a virtue then almost unknown, except among the Baptists, and upon the equality of all members of the state, a position which involved the stand against slavery. For the same reason, but in a humbler sphere of "testimonies," he refused to doff his hat to men of rank or place, or to address them with the plural pronoun "you," when, as was the custom, servants and common folk were addressed with "thou" and "thee." To justify this innovation, Fox published in 1660, with the aid of Stubbs and Furley, who provided the necessary scholarship, a book called *The Battledoor*; it showed from the pronouns of a long list of foreign tongues that "thou" and "thee" are the only correct forms for the second person singular. As a specimen of Quaker controversy this rare book is noteworthy enough. For the same reason—immanence of the Divine Spirit—the Quaker avoided forms and written creeds, rejected music and all other aids which art extends to religion, and, since God dwells in the heart and not in wood or stone, built the meeting-house as simply as was possible. A good example of earliest Quaker architecture is the building at Ulverstone, still known as Fox's chapel. For the same reason, moreover, the Quaker proclaimed a baptism of repentance and conviction, instead of baptism by water, and the communion of the spirit rather than the breaking of bread. No intellectual preparation can insure spiritual gifts; Oxford and Cambridge, ran George Fox's quaint saying, could not make a minister; and hence the Quaker's testimony against paid preachers. On the other hand, he created an ecclesiastical democracy, gave women equal rights with men, not only in the ministry, but in the conduct of business, and allowed any member to lift up voice in the meetings for worship, provided that the speaker was truly "moved" by the Spirit. Not the least logical outcome of this central doctrine of the immanence of the Divine Spirit was the silent meeting, "frost of the mouth and thaw of the mind"; in a quiet broken by no human voice each heart could commune with God.

Whatever might be the emphasis which Quakers laid upon this central fact of spiritual guidance, it is quite untrue that they rejected the authority of Scripture. Fox contended not that the Bible was without binding authority, but that it should be read invariably by the light of the Spirit. "I saw," he tells us, "that Christ died for all—was a propitiation for all, and that the manifestation of the spirit of God was given to every man to profit withal. These things I did not see by the help of man, nor by the letter of Scripture; but I saw them in the light of the Lord Jesus Christ and by his immediate spirit and power, as did the holy men of God by whom the Holy Scriptures were written; yet the Holy Scriptures were very precious to me, for I was in that spirit by which they were given forth." Indeed it was the teaching of the Bible which led Fox and his followers to put a literal interpretation upon the command of Christ, "Swear not at all"; and although this refusal to take oaths led them into their chief difficulties with the state, bringing upon them persecutions of the most cruel character, they refused to bate a jot of their testimony, and have been the pioneers of the modern custom of affirmation. Another command—"Thou shalt not kill"—was regarded as putting an absolute ban upon all military service; when Fox was asked to be a captain in the Puritan army, he replied that he was "in love with all men, and could not fight against any." Simplicity was the keynote of Friends' ordinary conduct, plainness of speech, plainness of dress and behavior; the guidance of the Holy Spirit was to lead the Quaker through the minutest details of his life, and would stamp his walk and conversation, so he believed, with the mark of primitive Christianity. In the last resort he must always consult the monitor within. When a convert of gentle rank came to Fox and asked whether he should continue to wear his sword, the founder answered, "Wear it as long as thou canst."

The famous *Apology* of Robert Barclay contains a logical exposition of the doctrines of Friends; but George Fox himself put forth a declaration of belief in a letter addressed in 1671 to the governor of Barbados, which was intended to convince the authorities that the new sect was at one with the Church in regard to fundamental beliefs of Christianity, and had nothing in its doctrines which could prove harmful to the state. This letter, together with the *Apology* and the doctrinal writings of William Penn and others of his time, gives us clear insight into the belief of the founder and his adherents. These early converts or fellows of Fox were drawn from all classes of society; the time was full of religious disintegration, and gentle souls of every sect and standing gathered about the preacher of tolerance, simplicity, and the life of the spirit. Gentlemen, officers in the army, clergymen, shepherds, household servants, tradesmen, all sorts and conditions of men, were allied with Fox. Twice he visited the Continent; spent some time in Scotland, where he converted Col. David Barclay ("Barclay of Ury") and his famous son Robert; and twice journeyed to America, passing two years in what was then almost a wilderness. His early ministrations, which began in 1647, were full of persecution and privation of every sort. He was beaten by a mob and left for dead; abuse of every sort, imprisonment in the loathsome jails of that time, exposure, lack of decent food—all failed to touch his indomitable spirit. That time of persecution was rich in converts. In churches—laymen, as we know, often preached from the pulpits of Puritan England—at market-crosses, up and down the land, George Fox called men of all sects to a life in the spirit and in the simplicity of truth. His preaching was powerful, his fervor intense: "Take thine eyes off me," cried one who disputed with him, "they pierce me so"; and William Penn has borne testimony to the founder's power in supplication: "The most awful living reverent frame I ever felt or beheld was his in prayer." Fox was most successful in the northern counties of England, and soon saw a little army of preachers at his side. Persecution only fed the flame. By 1662 there were over 4,000 Friends in prison at one time; in twenty years 243 are said to have died from cruel treatment. There were other trials. The profligacy of certain Dissenters, the insane and extravagant acts of others—in a few cases, it must be admitted, of Friends themselves—involved in undeserved condemnation a sect which insisted from the start upon simplicity of conduct, rigid morals, and complete obedience to the civil authorities. At one time the lack of coherence in the society combined in such a degree with the persecution from without that there was danger of total destruction. It was here that the dignity, the persuasive power, and the organizing genius of Fox brought order and discipline among his followers, and laid the abiding foundation of the society. To this organization there was considerable resistance, led by Wilkinson, Rogers, Story, and others, who objected to any outward restraint upon the freedom of each soul and its peculiar spiritual guidance. However, the establishment of order took its course. The society had been held together by the sympathy of common aims and common suffering, by the ministers who journeyed from one assembly to another, and by stated general meetings, held four times in the year, where several conventions came together. As early as 1666 Fox established that unit of ecclesiastical order among Friends, the monthly meeting. Regular houses for worship were provided, not without a harmless legal artifice involving tenants and household furniture. In 1672 a yearly meeting was held in London; and in 1675 articles of discipline were communicated to the quarterly meetings. In 1688 violent persecution came to an end, and the society could perfect its organization undisturbed; two years later George Fox died, and Quakerism entered upon its second period of development.

Later History.—The society was not confined to the limits of Great Britain. In 1660 a general epistle mentions "the great work and service of the Lord beyond the seas," in Germany, Italy, Rome, Turkey, Norway, Barbados, and America, where "Friends have passed in the service of the Lord." Nearly £500 was appropriated at this time for such missionary work. A woman Friend was admitted to audience by the "Great Turk," and found courteous treatment; while two others of the same sex met a very different reception at the hands of the Inquisition in Malta. Permanent branches of the society were established in Germany, France, and Norway, where they still exist, although in diminished numbers. Prominent among the Dutch members was Sewel, historian of early Quakerism. In Scotland the body of Friends has never been large, but their numbers in Ireland are still respectable. A small settlement has been made in Australia. But it was North America that became the most important colony of Quakerism. Here, in the New World as in the Old, the history of the society begins with a period of persecution. As early as 1656 two Quaker women came to Boston, were searched for signs of witchcraft, imprisoned, and banished with strict injunctions never to return. Others coming into the colony, laws were passed against this Quaker heresy, with mutilation for offenders, and death for the obstinate. In a few cases zeal carried the Quakers to deplorable lengths of fanaticism; but the cruelty of their persecutors is not to be defended, and the courage of men and women who returned to stripes, to mutilations, and to death is not to be denied. Three men and one woman were hanged; but further severities were checked by a mandate of Charles II., obtained by the influence of English Friends. Many of these, meanwhile, began to seek homes in New York, Rhode Island, and other parts of America. In 1674 Quakers bought Lord Berkeley's interest in the Jerseys; in 1677 they founded the town of Burlington, and soon published the democratic and liberal laws of New Jersey. Their first colonial assembly met in 1681, a body made up for the most part of Quakers; and in the same year Penn obtained from Charles II. the grant of his famous colony. The history of this "Holy Experiment," its successes and failures, must be read elsewhere; enough to note that the influence of Quakerism in the foundation and development of Pennsylvania was distinctly for good.

The first zeal of Quakerism, the power to make converts and extend its borders, ceased with the death of its founder. The absence of persecution may have contributed to this state of affairs. Testimonies hardened into tradition and almost into a ritual. The rigid morals and prevailing integrity of Friends engendered public confidence in their dealings, and since their scruples about an oath excluded them, especially in England, from the universities and from the professions, it was only natural that they should be found chiefly in trade and manufactures. Simplicity and economy in private life enabled many of them to accumulate large fortunes; and the same necessity of restricted household expenditures encouraged them to liberal benefactions. It must be remembered, however, that his simplicity of life and limited outlay of money won for the Quaker another reputation, and often made him play in public esteem the part of a niggard and a worshiper of money. The Quaker in Fielding's *Tom Jones* is an instance, and a later writer than Fielding alludes to the

> . . . broad-brim'd hawker of holy things,
> Whose ear is stuff'd with his cotton, and rings
> Even in dreams to the chink of his pence.

Against these not too generous hints may be placed the undoubted facts of Quaker philanthropy. George Fox indicated many needed reforms. He protested against capital punishment for such offenses as larceny, and heralded the general protest of the society against a death-penalty for crime. He spoke distinctly against the keeping of slaves. In America, Friends began and maintained protest against slavery. In 1688 the Germantown meeting published such a protest. Franklin, in a letter to John Wright, of London, dated Nov. 4, 1787, recalls several occasions where Friends took similar action, notably a meeting held at Philadelphia in 1693; and he mentions books against slavery which he himself printed for the society. John Woolman worked nobly in the cause; by 1776, although a colony like New Jersey counted over 12,000 slaves, in the neighboring meeting of New York to own slaves meant loss of membership. Whittier, himself foremost in the cause, has given an admirable account of this whole matter in the introduction to his edition of John Woolman's *Journal*. Again, in the substitution of arbitration for war Friends have been distinctly prominent; Franklin approved their efforts in this direction (see a speech of his in Bigelow's *Life of Franklin*, iii., 393). Among other Quakers who have been active pioneers in reforms of different kinds are Lancaster in education, Elizabeth Fry among the prisoners, John Bright and W. E. Forster in politics, and Tuke in treatment of the insane. In science there are names like Dalton and Young, while the records of trade and industry would show a long and honorable list of Friends. It may be claimed that the society has influenced public life more than any other religious body of its size.

Schism.—The testimonies of a "peculiar people," the absence of all forms in worship, the principle of birthright membership, and the strict precautions against marriage with those beyond the pale, contributed to stop the growth of the sect. As long as the milder but vexatious phases of social persecution continued Friends were welded into comparative unity; but with prosperity came division and discord. The great division of 1827, which had its center in Philadelphia yearly meeting, worked havoc in the meetings of New York and Baltimore as well, and brought about a permanent separation of Friends in the U. S. The controversy was bitter; it caused disputes about property, broke up old friendships, and led to many social and legal complications, but eventually an excellent feeling between the two branches was created, and some attempts have been made at a permanent reconciliation. It is, however, improbable that a satisfactory basis can be found for corporate union.

The causes of this division are evident. In its very foundation Quakerism had two distinct tendencies. One affirmed independence of the letter of Scripture, and emphasized the right of each soul to follow the guidance of the Spirit. The other tendency—shown in George Fox's letter to the governor of Barbados—was fain to square the belief of Quakerism with the creeds of evangelical Christianity. The separation of 1827–28 was upon these lines. One party, the so-called "Hicksites," protested against unwarranted interference with the liberty of individual belief. The other party, known as "Orthodox," protested against those ministers, notably Elias Hicks, who threw doubt upon the absolute divinity of Christ and the full meaning of the atonement. A total separation ensued, so far as the U. S. were concerned, in the society at large, the Hicksites taking a majority of Friends in the Middle States. In England, where the yearly meeting sided with the "Orthodox" branch of American Quakers, no separation of the sort took place. Another division, however, was made in the U. S. In 1837, J. J. Gurney, an English Friend, was engaged in religious work in New England; John Wilbur, a native preacher, who charged Gurney with unsound, i. e. ultra-evangelical, doctrine, was disowned for his proceedings, and took with him a minority of the yearly meeting, who are now known as "Wilburites."

Organization.—Friends distinguish between meetings for worship and meetings for discipline. In the latter only members of the society may take part. True to the central doctrine of the society, they do not record decisions of a deliberative body by the ordinary course of a majority vote; but the clerk of the meeting, on whom rests the chief responsibility and who is accordingly one of the foremost members, is authorized to take "the sense of the meeting," after opinions have been expressed by individual members. In other words, the meeting is held under the guidance of the Holy Spirit. When unity of sentiment is wanting the question is either deferred or dismissed. In the same way Friends do not undertake to appoint their ministers. A meeting of ministers and elders records its approval of a certain person's "gift" in the ministry, and the person in question is thenceforth a recommended minister. It is customary for meetings to give a minute of unity to such ministers of their body as desire to travel in the service of the gospel. Women have their business meeting separate from that of the men, but with a similar organization and nearly equal jurisdiction. In addition to the clerk of the meeting and the ministers whom it recognizes, there are officers known as elders and overseers. The elders "watch over the spiritual interests of the congregation." The overseers deal with matters of discipline, and special committees are appointed for the management of property. These things touch the society as a whole. Regarding the conduct of individuals, in addition to the duties of the elders to admonish the wayward, the so-called *Queries* deserve notice. These are read at meetings for business, and are answered from the smaller to the larger body, until the yearly meeting gathers the general results. These queries touch the various ways in which Friends' testimonies are maintained. Finally a code, made up of rules adopted from time to time, is printed for the use of meetings generally, and is known as the *Discipline*.

The monthly meeting is the real source of power. A certain amount of business is prepared for it at a meeting of each particular congregation, the preparative meeting. But the monthly meeting controls membership in the society, admits or disowns, regulates marriage, raises money for the needs of the Church, educates orphans and destitute children, cares for the poor, grants certificates to ministers traveling abroad, and deals with all cases involving the morals or business affairs of its members. The quarterly meeting, held four times in the year, embraces several monthly meetings, and is a body of appeal from them. It has a wider supervision, and recommends changes for the action of the yearly meeting. The yearly meeting covers a large district with its various quarterly meetings, and is a body of final appeal. In the U. S. the Orthodox branch has thirteen of these; the Hicksites have seven. The yearly meetings maintain correspondence with one another, but are mutually independent. Each of them appoints a standing committee, the official representation of the yearly meeting itself, to carry the doctrine of Friends into active public service; this is known as the representative meeting, except in Philadelphia, where it goes under the name of the Meeting for Sufferings, since it once found its chief business in attending to the wants of members who were exposed to persecution, to distraint upon property on account of refusal to bear arms, or to the perils of Indian incursions. These needs no longer existing, the meeting now issues publications in regard to temperance, peace, and the like; or else appeals to the Government for the suppression of vice or abuses. It may be called one of the aggressive phases of Quakerism left in an organized form.

Statistics.—By the census of 1890 there were in the U. S. 80,655 members of the Orthodox branch of the society; only one-sixth of these belonged to the older yearly meetings of Philadelphia, New York, New England, and Baltimore. Indiana yearly meeting alone had 22,105 members. In the so-called Hicksite branch there were 21,992. Of minor divisions the so-called Wilburites counted 4,329 and the Primitive Friends 232. The statistical returns of the Society of Friends for 1898, published in Jan., 1899, show that the number connected with it throughout the world was 113,877: in the U. S. 93,699, and in Great Britain and its colonies and on the continent of Europe 20,178. The society included 14 yearly meetings in America, 2 in Great Britain, 5 on the continent of Europe, and 6 in Australasia, with mission stations in every quarter of the globe. The total number of recognized ministers was 1,648. The tables for 1899 gave the total number of Friends at 113,580. The American yearly meetings returned 93,699 members and 1,279 ministers; the yearly meetings of Great Britain 17,153 members. In some meetings there is a paid "pastor," and singing, even instrumental music, has been introduced in public worship.

The society counts a respectable number of periodicals. The Orthodox branch publishes in England *The Friend*, *The British Friend*, and *The Friends' Quarterly Examiner*; in the U. S. *The Friend*, *The Friends' Review*, and *The Christian Worker*. The Hicksite branch publishes in Philadelphia *The Friends' Intelligencer*. Education has received due attention. Ackworth School and the Flounders Institute, an institution for training teachers, are in England. In the U. S. Westtown Boarding-school counts nearly a century of valuable work, while the Friends' School at Providence was founded in 1819. Each is under the care of its yearly meeting. Haverford College, near Philadelphia, was founded by members of the Orthodox branch as early as 1833, and Swarthmore College by the Hicksites in 1870. The latter is for both sexes, Haverford for young men; but Bryn Mawr College, for women, was founded by Dr. Joseph W. Taylor, an Orthodox Friend, and is managed by trustees, who must be members of that body. Wilmington, Earlham, and Penn are Orthodox colleges in the Western States; Guilford College, of the same branch, is in North Carolina.

Bibliography.—The literature of the society is very extensive, particularly for the early days of controversy. A *Catalogue of Friends' Books* was published by John Whiting in 1708; and when this was long out of print, Joseph Smith, of London, prepared *A Descriptive Catalogue of Friends' Books* (2 vols., London, 1867). A supplement was issued in 1893. The list is of books *written by members of the society*; but many works are catalogued which were written against Quakerism, and the bulky work is invaluable to every student of Quaker history. Among the more important books are the *Journal of George Fox* (London, 1694, and often reprinted); *History of the Life of Thomas Ellwood* (1714); Robert Barclay's *Apology for the True Christian Divinity as the Same is held forth and Preached by the People called in scorn Quakers* (in Latin, Amsterdam, 1676; English edition, London, 1678), the standard doctrinal work of Quakerism; William Sewel (of Amsterdam), *History of the Rise, Increase, and Progress of the Christian People called Quakers* (London, 1722); James Bowden, *History of the Society of Friends in America* (London, 2 vols., 1850–54); the various writings of William Penn for older phases, and for modern, those of J. J. Gurney; for the separation in America, Thomas Evans, *Exposition of the Faith of the Society of Friends* (Philadelphia, 1827; the Orthodox view); and *History of the Society of Friends*, by Samuel M. Janney (4 vols., 1859–67): vol. iv. gives an account of the separation, from the Hicksite point of view. Recent popular works are *Quaker Strongholds*, by Caroline Stephen; *The Quakers*, by F. Storrs Turner; and *The Friends*, by William Beck. FRANCIS B. GUMMERE.

Fries, frees, ELIAS MAGNUS: botanist; b. in Sweden, Aug. 15, 1794; became adjunct Professor of Botany at Lund 1819; professor there 1828; received the professorship of Economy at Upsala in 1834, and that of Botany also in 1851; became rector of the university in 1853. He was chiefly distinguished as a student of the mosses, seaweeds, lichens, etc.; author of *Systema Orbis Vegetabilium* (1825); *Corpus Florarum Provincialium Sueciæ* (1835); *Summa Vegetabilium Scandinaviæ* (1846–48), etc. D. Feb. 8, 1878.—His son THEODORE is Professor of Botany at Upsala, and conducted a botanical expedition to Spitzbergen.—Another son, M. E. P. FRIES, is a distinguished student of cryptogamic botany.

Fries, JACOB FRIEDRICH: philosopher; b. at Barby, near Magdeburg, Aug. 23, 1773; was trained in the Moravian seminary of his native place, and then studied at the Universities of Leipzig and Jena; began in 1801 to lecture at Jena, and in 1805, after having traveled in Germany, Switzerland, France, and Italy, was made Professor of Philosophy and Elementary Mathematics at Heidelberg; in 1816 returned to Jena as Professor of Theoretical Philosophy, and, though deposed for political reasons (from 1819–24), he remained there until his death, Aug. 10, 1843. In philosophy he followed the doctrines of Kant, but he believed that his master's method needed perfecting, because it confounded psychological ideas with philosophy properly so called, and does not strictly distinguish the aids that psychology furnishes to metaphysics from metaphysics themselves. By a blending of Jacobian conceptions with the philosophy of Kant, Fries developed the doctrine that the sensible is the object of knowledge, the suprasensible the object of faith (rational faith), and the manifestation or revelation of the suprasensible in the sensible the object of presentiment. He called his system "philosophical anthropology," since he made all further knowledge dependent on man's self-knowledge. Dr. Edwards thus comments upon it: "The philosophy of Fries commends itself in this, that it preserved the formal logical reflection of Kant without sharing in the metaphysical insipidity—yea, emptiness—of the contents of that philosophy." (*Bibliotheca Sacra*, 1850, p. 780.) His most important work is *Neue Kritik der Vernunft* (Heidelberg, 1807; 2d ed. 1828–31). See Henke, *Jakob Friedrich Fries, aus seinem handschriftlichen Nachlasse dargestellt* (Leipzig, 1867, 8vo); Ueberweg, *History of Philosophy* (New York, 1873, ii., 195, 201–203).

Friesen, free'zen, RICHARD, Baron, von: statesman; b. at Thürnesdorf, near Königstein, Saxony, Aug. 9, 1808. He was educated in the royal school of Meissen, the mining-school at Freiberg, and the Universities of Göttingen and Leipzig; entered the services of the Government in 1834. In May, 1849, when the revolution broke out in Dresden, he distinguished himself by his coolness and his firm adherence to the Government, in the midst of the general confusion, taking charge of the Ministry of the Interior; differences between him and the Minister of State, von Beust, caused him to retire in 1852, but in 1859 he was recalled and appointed Minister of Finance; member of the committee which governed the country during the war and the absence of the king 1866; after the war he took charge also of the Ministry of Foreign Affairs; deputy from Saxony to the council of the North German Confederation 1867. In 1870 he favored the formation of the German empire; represented Saxony in the Imperial Diet; president of the Saxon ministry 1871–76. D. Feb. 25, 1884. Author of *Erinnerungen aus meinem Leben* (2 vols., 2d ed. 1881).
Revised by C. H. THURBER.

Friesland, freez'land: province of Holland; bounded N. and W. by the North Sea and the Zuyder Zee and E. and S. by Groningen and Overyssel; area about 1,280 sq. miles; pop. (1895) 338,911. The country is low and level, intersected by canals, and has excellent pastures. Butter and cheese are the main exports; flax and hemp are grown in large quantities. The principal town is Leeuwarden. East Friesland is now the district of Aurich in Hanover.

Frieze [M. Eng. *fryse*: O. Fr. *frise* > Fr. *frise*, from Mediæv. Lat. *frisius* or *pannus frisius*, perhaps liter. Frisian cloth]; a coarse woolen cloth having a shaggy nap upon one side, and once much employed for making cloaks and jackets for laboring men. The Low Countries were a principal seat of the frieze manufacture, and hand-woven friezes of good quality are still manufactured in Ireland.

Frieze [from O. Fr. *frise* > Fr. *frise*: Ital. *fregio* (older *frigio*) < Mediæv. Lat. *phrygium*, *frigium*, *frisium*, appar. liter. Phrygian work. Or the word may be from the same source as *frieze*, a kind of cloth]: in architecture, generally a decorated horizontal band or belt. It is used in a more specific and technical sense to designate the band or member between the architrave and cornice of an entablature of the classic type, whether plain or ornamented. In ancient Greek architecture the frieze was frequently decorated with sculpture and called the *zoöphoros*; the Romans more often adorned it with conventional carved ornaments or grotesque and symbolic forms. The Doric order, as used by both these peoples, had a frieze of alternate metopes and triglyphs; the other orders had no distinguishing type of frieze (see ARCHITECTURE and DORIC ORDER). The metopes were frequently decorated with sculpture in high relief, as in the Parthenon, or with painted ornaments, as is supposed to have been the case on the lateral friezes of the Theseum at Athens. The most celebrated of ancient friezes is, however, the one which, forming no part of an entablature, once surrounded the upper part of the Parthenon cella-wall, immediately under the ceiling of the colonnade, and of which the greater part is now in the British Museum. It represents a religious festival procession in two uninterrupted compositions, 500 feet in total length and about 4 feet wide. One procession seems to move along the south front, the other along the west and north fronts, to the point where they both meet in the east front and where the high ceremony takes place. The figures of deities, priests, worshipers, and horses are treated in low relief with consummate skill, and the whole work is considered one of the masterpieces of the school of Phidias (440 B. C.).

In the Middle Ages decorative friezes were rarely produced, the requirements of Gothic architecture demanding emphasis of vertical rather than of horizontal lines. The Renaissance, however, revived the practices of Roman design, and the decoration of horizontal bands and friezes with carved ornament of the most sumptuous kind, employing classic symbols, arabesques, and acanthus-leaved scrolls or *rinceaux*, was executed with consummate skill.

In interior design the upper part of a wall, more richly decorated than the portion below and separated from it by a molding or architrave, is called the frieze, and in some modern buildings is treated with painted processions or other figure compositions of an allegorical or commemorative character. A. D. F. HAMLIN.

Frieze, HENRY SIMMONS, LL. D.: educator; b. in Boston, Mass., Sept. 15, 1817; graduated at Brown University 1841; instructor there 1841–45, and then at the grammar school of the university till 1854, when he became Professor of the Latin Language and Literature at the University of Michigan. He was an able and popular teacher and an excellent manager of the interests of the university, which were twice intrusted to his care as acting president, 1869–71 and 1880–

81. He caused the privileges of the university to be extended to women, obtained a valuable library of political science, and secured from the Legislature an appropriation of $75,000 for the university. The official connection between the university and the high schools of the State is also due largely to his efforts. D. at Ann Arbor, Mich., Dec. 7, 1889. Besides his valuable annual reports to the board of regents and occasional addresses, he published an edition of Vergil's *Æneid* (1860) and of Quintilian (1867), and wrote *The Story of Giovanni Dupré* (London, 1886).

Frigate Bird, or **Man-of-war Bird**: a bird of the family *Fregatidæ*, order *Steganopodes*, related to the pelicans. They are distinguished by a long, deeply forked tail, narrow, elongate wings, a small pouch under the bill, and a rather stout, straight bill, hooked at the tip. The body is small, the spread of wings 7 to 8 feet, the tarsus relatively the shortest among birds. These birds are remarkable for their powers of flight, and are said to catch flying-fish on the wing. They are most audacious robbers, lying in wait for gannets, fish-hawks, and other birds, and forcing them to drop or disgorge their food, which is seized before it can fall to the water. There are two species, *Fregata aquila*, found throughout tropical waters and common on the coast of Florida, and *F. minor*, confined to portions of the Indian and Pacific Oceans. F. A. LUCAS.

Frigg, or **Frig'ga**: in the Scandinavian mythology, the wife of Odin and the most venerable of goddesses. She dwelt at Fensalir, and was the goddess of marriage and of fruitfulness. Some say that *Friday* was "Frigga's day"; others say that "Freya's day" is intended. See FREYA.

Frigid Zone [*frigid* is from Lat. *fri'gidus*, cold (> Fr. *froid*, cold), deriv. of *frige're*, be cold, deriv. of *frigus*, cold : Gr. *ῥῖγος*, cold]: in geography, the arctic and antarctic regions; the portions of the earth's surface which lie respectively N. of the arctic and S. of the antarctic circle. The north and south frigid zones have each an area of very nearly 8,229,748 sq. miles, and within these zones the sun does not rise and set every day of twenty-four hours. See EARTH.

Frilled Lizard: See CHLAMYDOSAURUS.

Fringe-tree, or **Old Man's Beard**: a beautiful ornamental shrub of the U. S., growing as far N. as Pennsylvania and southward to Florida. It is the *Chionanthus virginica* of the family *Oleaceæ*. Its petals are white and curiously fringed, whence the name. It has an oval purple fruit, and leaves which are extremely variable in shape. Other species are found in Australia and the tropical regions of both hemispheres. A distinct plant, the *Rhus cotinus* of the Old World, is sometimes called fringe-tree, but it is more properly known as smoke-tree or Venetian sumac, and it is also known as wig-tree. Revised by L. H. BAILEY.

Fringil'lidæ [from Mod. Lat. *Fringilla*, one of the genera]: a family of small oscinine birds, characterized by a conical beak, whose cutting edges are bent downward at an angle near the base of the bill. The nostrils are well up in the basal portion of the beak, the primaries are nine, the tail-feathers twelve in number. While the beak is always conical, it varies from the comparatively slight form found in the snow-bunting to the massive bill of the grosbeak and the curious crossed mandibles of the crossbills. The family is one of the most extensive among birds, numbering over 500 species, and including those known as sparrows, finches, buntings, and grosbeaks. The distribution is somewhat peculiar, for the family is not found in the Australian region, although represented elsewhere over the greater portion of the globe. F. A. LUCAS.

Frische Haff, frish'e-haaf' [Low Germ., fresh-water sea]: a lagoon on the coast of Prussia with an area of 318 sq. miles. In ancient days it formed a lake receiving the waters of the Pregel, Frisching, Passarge, and Vistula, and separated from the Baltic by a very narrow band of land, the Frische Nehrung. But in 1510 the Baltic broke through the Nehrung and formed a permanent passage from 10 to 15 feet deep, called the Gatt. Frische Haff is so shallow that all large vessels have to load and unload at Pillau, situated at the Gatt, from which the cargoes are transported over the Haff on lighters.

Frisi, free'sĕe, PAOLO, F. R. S.: scientist; b. at Milan, Italy, Apr. 13, 1728; became a Barnabite monk; held professorships of Philosophy at Casale and the Barnabite College, Milan; became in 1755 Professor of Morals and Metaphysics at Padua; in 1756 Professor of Mathematics in Pisa; and in 1764 took the mathematical professorship at the University of Milan, where he died Nov. 22, 1787. He was profoundly versed in mathematics and physics, and his dogmatic temper involved him in perpetual controversies. His works include a *Disquisitio Mathematica* (1751) upon the physical cause of the earth's figure and motion; *De Atmosphæra cœlestium corporum* (1758); *De Inæqualitate motus planetarum* (1760); *Del modo di regulare i Fiumi e i Torrenti* (1762); and many others.

Frisian (friz'i-an) **Language and Literature** [*Frisian* is deriv. of *Friese*, native of Friesland < O. Eng. *Frisa*, *Fresa*, from O. Fries. *Frise*, *Fresa*]: that branch of the Teutonic group of languages which was formerly spoken in Northwestern Germany—along the coast of the North Sea. Although at present confined to a few small and mostly isolated districts, Frisian may claim to be for a student of English philology one of the most important languages in forming a connecting link between Old English and the Low German dialects.

In earlier times almost the whole of the coast and the islands along the North Sea between the southern boundary of Jutland and the Zwin or Sincfal in West Flanders was occupied by Frisians. At only one point within these limits was the Frisian territory from the very earliest times intersected by a population of non-Frisian origin, the coast at both sides of the mouth of the Elbe having been at an early date occupied by tribes belonging to the Low Saxon group. Curiously enough it is this part of Germany, or more exactly part of this district (viz., Western Holsatia, between Elbe and Eider), from which the main body of the Teutonic conquerors of Britain is said to have come. As far back as Frisian can be traced its geographical area and the number of the Frisian-speaking population have been constantly diminishing, and compared with the original extent the present area is a very small one. But the scantiness of extent and number is in some degree offset both by the considerable difference existing among the modern Frisian dialects and by the evidences left of some of the earlier varieties.

Modern Frisian is to be divided into four groups, viz., Insular Frisian, North Frisian, East Frisian, and West Frisian. There is every reason to believe that the same division existed in the period from which the earliest literary documents date, although Insular Frisian and North Frisian are represented only by recent sources.

INSULAR FRISIAN is limited to the four islands Sylt, Föhr, Amrum, and Heligoland. Formerly the dialects of these islands were considered as forming part of North Frisian—an opinion which holds good so far as Insular Frisian shares with North Frisian certain peculiarities which are not found in either East or West Frisian. But as there are striking similarities between Insular Frisian—in distinction from the other Frisian dialects—and Old English, and as the relationship of Insular Frisian to Old English is apparently of an earlier date than the features which it has in common with North Frisian, it seems advisable (with Möller) to separate Insular from North Frisian in admitting a special insular branch of the Early Frisian or Anglo-Frisian language. This separation is furthermore recommended by the fact that the inhabitants of the four islands and of the Schleswig coast find difficulty in making themselves understood by each other in their own dialect, Low German being preferred for the sake of mutual communication. Insular Frisian is in itself by no means a uniform language. In fact each one of the four islands has its particular dialect, there being, moreover, a marked difference between the eastern and the western part of Föhr, so that five varieties of Insular Frisian may be distinguished. Three of these—viz., the "Amring" and the two "Föhring" dialects—have several points in common with each other and partly also with North Frisian, in which the two others disagree. The differences between "Sildring" and the "Amring-Föhring" dialects are so considerable that both parties have some difficulty in understanding each other, while the idiom of Heligoland takes a kind of an intermediate position between those of Sylt and of Amrum-Föhr. Heligoland has, to a larger extent than the language of the three other islands, submitted to the influence of Low German, its dialect being at present a mixture of Frisian and Low German. Low German has furthermore invaded the eastern part of Föhr, the borough of Wyk, and the villages Nieblum, Boldixum, and Wrixum, being at present entirely or almost entirely Low German. All of the literary sources for Insular Frisian are of a recent date, the earliest document being a translation of the Lord's Prayer into "Amring" printed in 1748. They consist of numerous poems (folk-songs, wedding songs, religious poems, etc.). sayings, anecdotes, fairy tales, brief translations from Modern German, vocabularies, etc. Part of these exist only in manuscript, the MS. collections left by the Amrum minister Mechlenburg and preserved in the municipal library of Hamburg being especially valuable.

North Frisian is spoken along the western coast of Schleswig from the Widau (near Tondern) southward as far as Husum. North Frisian is furthermore found on most of the so-called "Halligen" islands—viz., Hooge, Northmarsh-Langeness, Oland, Groede, Hamburgish Hallig, and Northstrandish Moor. As several of the latter islands are situated as near or even nearer to Amrum and Föhr than to the Schleswig coast, it may seem strange that their dialect agrees with North Frisian instead of Insular Frisian. But this is accounted for by the fact that the "Halligen" formerly belonged to the continent, from which they were detached by floods during the seventeenth century. There are (according to Siebs) seven varieties of North Frisian—viz., the dialects of (1) Hattstedt, (2) Brecklum, (3) the Halligen islands, (4) Ockholm, (5) Karrharde, (6) Moringen, (7) Wiedingharde. This is counting only the chief varieties, minor differences being found in almost each community. The literary sources of North Frisian, resembling in character those of Insular Frisian, are not numerous, and mostly of recent date. With the exception of a short inscription of a baptismal font at Büsum in Holsatia,* dating from the fourteenth or fifteenth century, and several poems from the "Hallige" Northstrand in a MS. from the year 1661, they belong to the second half of the eighteenth century and to the nineteenth century, the earliest print being a wedding song from Bendixen (in the Wiedingharde dialect) from 1749.

East Frisian is at present confined to two small districts in the grand duchy of Oldenburg—viz., to the island of Wangeroog (near the mouth of the Weser) and to the "Saterland," consisting of three parishes in the marshy land (about midway between the Weser and the Ems). Its area, however, was much larger in former times. In the thirteenth century East Frisian extended from the Lauwers (in the Dutch province of Groningen) to the Weser, including the islands opposite the coast, and beyond the Weser the district of Wursten. Fortunately several important literary documents dating from this earlier period are preserved, which enable one to form an adequate idea of the former condition of the East Frisian dialect, and to trace the outlines of its development from the Middle Ages down to the present time. The history of East Frisian, then, is to be divided into two periods, as follows:

(*a*) *Old East Frisian* (down to the end of the fifteenth century).—The oldest manuscript—dating at least from the thirteenth, but more probably from the twelfth or even the eleventh, century—is a small strip of parchment containing a few fragments of an interlinear version of the Psalms. Its dialect is distinctly East Frisian, but does not exactly coincide with that of any other Old East Frisian monument. The rest and by far the more important part of the sources consists of eleven manuscripts from the thirteenth, fourteenth, and fifteenth centuries, containing various collections (or fragments of collections) of Frisian laws. All of these MSS. but one (whose dialect has not yet been identified) have been traced to one of the five following districts: (1) Rüstringer Land, (2) Brokmer Land, (3) Hunsigo, (4) Emsigo, (5) Fivelgo, each of which had its own particular dialect. The language of the Old East Frisian law-books represents the earliest accessible stage in the development not only of East Frisian but of the whole Frisian group, and accordingly is often simply called "Old Frisian." In view of its grammatical condition, it is fully entitled to a name which places it on the same line with "Old High German" and "Old Saxon," although its documents do not precede in date those of Middle High German and Middle Low German. The political isolation of the Frisians and their conservative spirit, especially in regard to their legal institutions, seem to account for the archaic character of the language in which their ancient laws were handed down and codified during the Middle Ages.

(*b*) *Modern East Frisian* (from about 1500 to the present time).—From the end of the fifteenth century East Frisian in literary and oral use has been gradually superseded by Low German. The language which at present usually goes under the name of East Frisian (viz., the idiom of the Prussian province of East Friesland) is not a Frisian, but a Low German (Saxon) dialect. Frisian yielded to Low German in different districts at different times—e. g. in the district of Jever earlier than in that of Wursten, where Frisian did not die out before about the middle of the eighteenth century. Frisian was still alive in the district of Wursten, in 1688, when Luderus Westing, minister at Wremen, made a list of about 780 High German words, with their interpretation in Frisian. A similar vocabulary, and partly based on the same list of German words as that used by Westing, was filled out in 1691 by the minister Johann Cadovius-Müller at Stedesdorf in the Harlinger Land, who in an appendix added some specimens of Frisian texts, and called his collections *Memoriale linguæ Frisicæ*. Both of these lists furnish valuable materials for the more recent history of the East Frisian language. The former is especially important, as the Wursten dialect appears to be an immediate descendant of the same variety of Frisian which is found in the Old Frisian laws of Rüstringer Land. The dialect of the Harlinger Land, as recorded by Cadovius-Müller, is closely related to the Modern Frisian dialect of the island of Wangeroog. The latter, as well as the dialects of Wursten and Rüstringer Land, belongs to the *Weser* division of East Frisian, while the remnants of Frisian found in the Saterland—which probably descended from the Old Frisian dialect of the Emsigo—belong to the *Ems* division. Both varieties are at present gradually dying out, the remnants of East Frisian in Wangeroog and in the Saterland becoming more and more displaced by Low German.

West Frisian was originally found along the whole coast of the Netherlands and Belgium between the Lauwers (in the province of Groningen) and the Sincfal (in West Flanders). Part of their territory, however, was at an early date occupied by the neighboring Low German dialects. Low Saxon advancing from the east and Low Frankish from the south and west. At the time of the earliest literary sources pure Frisian was confined to the district between the Lauwers and the Flie, and at present it is preserved only in the Dutch province of Friesland and on the islands Schiermonnikoog and Terschelling. (See Dutch Language, where the boundaries between Frisian, Frankish, and Saxon are indicated.) Its literary documents admit of a division of the history of West Frisian into two periods.

(*a*) *Early West Frisian* (the West Frisian language of the fifteenth and sixteenth centuries).—The chief sources of the earlier West Frisian dialect consist of law-books, similar to those in East Frisian, but of a more recent date. They are contained in two manuscripts (the so-called *Jus municipale Frisonum*, from the year 1464, and the *Manuscriptum Roorda*, from the end of the fifteenth century), and in an early print, which is supposed to have been published either at Cologne or at Aanjum between the years 1460 and 1488. Another source of Early West Frisian consists of charters, deeds, and contracts from the fifteenth century and the first half of the sixteenth (the latest being from the year 1541). The language of these legal documents was in the fifteenth century already encroached upon by Low Frankish (i. e. Dutch) and Low Saxon, Frisian becoming during the sixteenth century more and more confined to private documents, and being entirely dropped in legal use after the middle of the sixteenth century.

(*b*) *Modern West Frisian* (from the beginning of the seventeenth century).—There are four distinct varieties of modern West Frisian spoken, viz.: 1. The dialect of Hindeloopen in the southwest corner of Friesland, where Frisian is preserved in an earlier form than in the other districts. 2. The dialects of the other districts of the province of Friesland, which constitute the main body of modern West Frisian. It is these dialects that generally are comprehended under the name of "Peasant-Frisian" (*Boerefriesch*), or "Country-Frisian" (*Landfriesch*). Several local varieties of continental West Frisian are found, but the differences are on the whole very slight. 3. The dialect of the island of Schiermonnikoog, preserved in the eastern and the western part of the island, while in the central part (in the village of Midsland) Dutch is spoken. 4. The dialect of the island of Terschelling. As to the dialects of the towns Leeuwarden, Bolsward, Sneek, Harlingen, Franeker, Dokkum, and of "Het Bildt" (the district along the northwestern coast of the province of Friesland), the

* The inscription—a survival of the former Frisian dialect of the "Hallige" Pellworm—is: *Disse hirren döpe de have wi thön ewigen ohntoncken mage lete, da shöllen össe berrne in kressent warde* (i. e. This brazen basin we have caused to be made for an eternal memory; therein our children shall be baptized).

name of "Platt-Frisian" (i. e. "Plattdeutsch"-Frisian, Low German Frisian), or "Town-Frisian" (*Sladfriesch*), is generally assigned; it ought to be said that the "Town-Frisian" is not to be counted among Frisian, the idiom of the towns in question being a Low Saxon dialect, which replaced the former Frisian language and kept only a comparatively small number of Frisian words and peculiarities. Similar to the idiom of the Frisian towns is that of the island of Ameland, where Frisian was still found in the year 1786. Modern West Frisian has been used and is being used for literary purposes to a greater extent than any other living Frisian dialect, the literary documents of Modern West Frisian commencing with the beginning of the seventeenth century, and the literary production being carried on both in poetry and in prose. Among the better known of the earlier works belong the *Friesche rijmlerije*, by the great Frisian poet Gijsbert Japicx (1668), and the story *It libben fen Aagtje Ijsbrants, of dy frieske boerinne*, by Eelke Meinderts (1779). Of favorite authors of modern times there should at least be mentioned the brothers J. H. and E. Halbertsma (the ardent and successful advocates of Frisian language and nationality), Waling Dijkstra (the most prolific and popular Frisian author), T. G. van der Meulen, and P. J. Troelstra. The interest taken among the West Frisians in the study of earlier and in the conservation of modern Frisian is also manifested by the foundation in 1829 of the *Friesch Genootschap* (i. e. Frisian Association), and in 1844 of the *Selskip for Fryske tael-en skriftenkennisse* (i. e. Society for the Study of Frisian Language and Literature).

References.—On Frisian and its dialects in general, see Johan Winkler, *Over de taal en de tongvallen der Friesen* (Leeuwarden, 1868); the same author's *Algemeen Nederduitsch en Friesch dialeclicon* (2 vols., The Hague, 1874; with specimens of the modern Frisian dialects); Hewett, *The Frisian Language and Literature* (Ithaca, 1879); Siebs, *Zur Geschichte der Englisch-Friesischen Sprache I.* (Halle, 1889; with a full bibliographical list of books for the study of Frisian and of Frisian texts); and the same author's *Geschichte der Friesischen Sprache* in Paul's *Grundriss der german. Philologie*, vol. i., p. 723, *sqq.* (Strassburg, 1891). Specimens of Frisian dialects are also found in Firmenich's *Germanien's Völkerstimmen* (Berlin, 1843–68); and Leopold's *Van de Schelde tot de Weichsel* (Groningen, 1882). A comparative Frisian grammar was long ago proposed by Prof. H. Möller, of Copenhagen, who, however, has since been engaged upon other work. Siebs's *Englisch-Friesische Sprache* attempts to combine a comparative treatment of the Frisian dialects with the reconstruction of the Anglo-Frisian language; its first volume contains, besides an introduction and a bibliography, only the vowels of the stem-syllables. A chapter of especial interest for Anglo-Saxon grammar, viz., that of the Frisian palatal consonants, was studied by Möller, *Die Palatalreihe der indogerm. Grundsprache im Germanischen* (Leipzig, 1875), and Siebs, *Die Assibilierung der Friesischen Palatalen* (Tübingen, 1887). On Frisian literature in general, see especially Th. Siebs in Paul's *Grundriss* (vol. ii., pt. 1, p. 494, *sqq.*, 1893).

Insular Frisian and North Frisian.—As regards the separation of Insular from the North Frisian, the theory of Möller's, referred to in the text, is found in his book *Das Altenglische Volksepos* (Kiel, 1883, p. 85). Compare the valuable essay by Bremer, *Einleitung zu einer Amringisch-Föhringischen Sprachlehre*, in the *Jahrbuch* of the Low German Dialect Society, vol. xiii. (Norden and Leipzig, 1887, p. 1, *sqq.*). On single dialects, see Johansen, *Die Nordfriesische Sprache, nach der Föhringer und Amrumer Mundart* (Kiel, 1862), and Bendsen, *Die Nordfriesische Sprache nach der Moringer Mundart* (Leyden, 1860).

East Frisian. (*a*) *Old East Frisian.*—The fragments of the Old Frisian translation of the Psalms were published by J. H. Gallée in the *Zeitschrift für deutsches Altertum*, vol. xxxii. (1888, p. 417). The best collection of the Old Frisian law-books is that by von Richthofen, *Friesische Rechtsquellen* (Berlin, 1840), to which von Richthofen added a complete dictionary (*Altfriesisches Wörterbuch*, Göttingen, 1840). Von Richthofen's works created a reliable foundation for the study of the Old Frisian language, and rendered the former Old Frisian grammars by J. Grimm (in his *Deutsche Grammatik*) and by Rask (Copenhagen, 1825) rather antiquated. A brief sketch of Old Frisian phonology and inflexion was then given by M. Heyne in his *Kurze Laut- und Flexionslehre der altgerm. Dialekte* (Paderborn, 1862; 4th ed. 1881). A recent and exhaustive treatment of the same subject is Van Helten's admirable *Allostfriesische Grammatik* (Leeuwarden, 1890). Compare also, especially for the Rüstringer dialect, Siebs's *Geschichte der Fries. Sprache* (mentioned above).

(*b*) *Modern East Frisian.*—Cadovius-Müller's *Memoriale linguæ Frisicæ* was edited by Kükelhan (Leer, 1875), and Westing's *Vocabulary*, by Bremer, in Paul and Braune's *Beiträge*, vol. xiii. (Halle, 1888, p. 530, *sqq.*). For the present East Frisian dialect, see especially the essays by Ehrentraut and Minssen in the former's *Friesisches Archiv* (vols. i., ii., Oldenburg, 1847–54).

West Frisian. (*a*) *Early West Frisian.*—Some of the West Frisian law-books are printed in von Richthofen's *Altfries. Rechtsquellen* (quoted above under East Frisian) and in M. de Haan Hettema's *Jurisprudentia Frisica* (Leeuwarden, 1834–35). For charters and deeds, see E. Epkema's *Verzameling van vroegere charters, meest in den oudfrieschen longval*, in Visser and Amersfoordt's *Archief* (3 vols., Leeuwarden, 1824–28). Compare M. de Haan Hettema's *Idioticum Frisicum* (Leeuwarden, 1874).

(*b*) *Modern West Frisian.*—Selections from Frisian works of the seventeenth, eighteenth, and the nineteenth centuries are found in the second and third volumes of F. Buitenrust Hettema's *Bloemlezing uit oud-, middel-, en nieuwfriesche geschriften* (Leyden, 1887–90). Reprints of Gijsbert Japicx's *Friesche rijmlerije* were published by E. Epkema (Leeuwarden, 1821–24, with a comprehensive dictionary) and by W. Dijkstra (Franeker, 1853). The latter also reprinted the *Libben fen Aagtje Ijsbrants* (Leeuwarden, 1861). For the works of the two Halbertsma, W. Dijkstra, Van der Meulen, and other modern Frisian authors, see the bibliography in Siebs's *Englisch-Friesische Sprache* (p. 368, *sqq.*), and the same author's sketch of the history of Frisian literature in Paul's *Grundriss* (vol. ii., pt. 1). Compare G. Colmjon's *Beknopte friesche spraakkunst voor den tegenwoordigen tijd* (Leeuwarden, 1863; 2d ed. by van Blom, 1889); J. H. Halbertsma, *Over de uitspraak van het landfriesch* (in Taalgids, vol. ix., p. 1, *sqq.*); and the books on Dutch dialects quoted in the article Dutch Language.

Hermann Collitz.

Frisians: the race that inhabits a territory lying along the German Ocean between the Scheldt and Weser, which includes the modern divisions of Friesland in Holland and Aurich in Hanover. Their history goes back to very early times. Between 28 and 57 A. D. they came in conflict with the Romans, but were only nominally subjugated. They probably aided their neighbors, the Angles and Saxons, in the conquest of England and Scotland. Wilfrid of York established the first successful mission among them in 677–78. Charlemagne absorbed their territory in his empire. The three divisions of the country, Western, Middle, and Eastern Frisia, passed through many political vicissitudes, but in the last a confederate form of independent republican government was long maintained. In modern times the people have not asserted themselves politically, but have been peacefully united with adjoining nationalities. C. H. T.

Frith, William Powell: genre-painter; b. in Studley, near Ripon, England, in 1819; pupil of Royal Academy, London; Royal Academician 1853; second-class medal, Paris Exposition, 1855; Legion of Honor 1878; member of Vienna, Antwerp, Swedish, and Belgian academies. *Derby Day* (1858), *Railway Station* (1862), and *Marriage of the Prince of Wales* (1865) are among his most important works. They are crowded with figures, and detail is carefully painted, but his compositions lack harmony of color, and his figures are not very well drawn. His works are very popular, and many of them have been engraved. Studio in London. W. A. C.

Frit'illary [from Mod. Lat. *fritilla'ria*, fritillary, deriv. of Lat. *fritil'lus*, dice-box, so called from the dice-like marks on the petals]: the *Fritillaria maleagris* of Europe, a liliaceous plant common in cultivation. The flower is spotted with purple, red, and yellow; hence it is often called checkered lily. Many varieties are grown in gardens. The crown imperial (*Fritillaria imperialis*) is a fine showy flower of Persian origin. There are some twenty species.

Fritsch, Johann: neurologist; b. at Tepl, Bohemia, Feb. 10, 1849; graduated at the gymnasium at Eger; studied medicine at the University of Vienna, and became Privatdocent of Psychiatry there. He is Landesgerichts Artzt in Vienna, editor of *Das Jahrbuch für Psychiatrie*, and has written *Ueber die primäre Verrücktheit* (1879); *Ueber die*

Verwirrtheit (1880); *Für Differentialdiagnose der Melancholie* (1879); *Erfahrungen über Simulation geistiger Störung* (1890), etc.

Fritschel, frit'shel, Gottfried. D. D.: Lutheran theologian; b. in Nuremberg, Germany, Dec. 19, 1836. Studied at Neuendettelsau and Erlangen; was Professor of Theology, St. Sebald, Iowa, and Mendota, Ill., from 1857 to his death, July 13, 1889. Published in German a history of missions among the North American Indians, a volume of Passion sermons, and was a prolific writer of review articles, bearing especially on the predestinarian and other controversies in the Lutheran Church of America.

Fritschel, Sigismund, D. D.: Lutheran theologian: b. in Nuremberg, Germany, Dec. 2, 1833; studied at Neuendettelsau; professor in Theological Seminary of German Synod of Iowa since its foundation in 1854. He is eminent as a debater and a writer of review articles. Editor, with his brother, for many years of the *Kirchliche Zeitschrift.*

Fritz, Samuel: Jesuit missionary; b. in Bohemia, 1653 He was sent to Peru, entered the Mainas missions of the upper Amazon in 1686, and in 1689 descended the river to Pará, where he was imprisoned by the Portuguese governor for two years; he then returned to Lima, and in 1693 resumed his labors on the Amazon. The Omaguas missions were founded by him, and he established thirty-nine Christian villages. Father Fritz explored the whole of the Amazon and many of its tributaries, and made the first reasonably good map of the river-system; this was first published at Quito in 1707, and was long the authority for this region. Died at the Jeberos mission, near Laguna, Peru, Mar. 20, 1728.

Herbert H. Smith.

Fritzsche, frit'she, Christian Friedrich: theologian; b. at Nauendorf, Germany, Aug. 17, 1776; was educated at Francke's orphan asylum and at Leipzig; became a Lutheran divine, and in 1830 Professor of Theology at Halle. In his latter years he was rationalistical. Author of *Vorlesungen über den Abendmahl*; *De anamartesia Jesu Christi* (1835–37); *De Revelationis Notione* (1828); was one of the authors of the *Fritzschiorum opuscula academica* (1838); and *Nova opuscula* (1846). D. at Zurich, Oct. 19, 1850.—His sons, Franz Volkmar (see below), Karl Friedrich August (1801–46), Otto Fridolin (b. 1812), and Adolf Theodor Hermann (1818–78), are or were all university professors and authors of learned works, mostly upon topics connected with Latin and Greek literature or the writings of the early Christian period.

Fritzsche, Franz Volkmar: Greek philologist and editor: son of the learned theologian C. F. Fritzsche; b. at Steinbach, in Saxony, Jan. 26, 1806; studied philology at the University of Leipzig under Beck and Hermann; held the position of assistant teacher (collaborator) for some years in the Thomas school in Leipzig, and was called thence to the professorship of Eloquence and Poetry in Rostock 1828. His earliest literary labors were connected with the style and writings of Lucian (Leipzig, 1826, 1828), some of whose dialogues he edited (*Dialogi Deorum*, Leipzig, 1829). He subsequently devoted his attention to the Greek theater and the Greek dramatists, especially the comedians. Besides the *Quæstiones Aristophaneæ* (Leipzig, 1835) and *De Dætalensibus atque de Babyloniis* (Leipzig, 1831), he edited, with a copious commentary, the *Thesmophoriazusæ* of Aristophanes (Leipzig, 1838), and the *Ranæ* (Zurich, 1845). In defense of his old teacher, Hermann, against Otfried Müller, Fritzsche published a *Recension des Buches Æschylos Eumeniden von K. O. Müller* (Leipzig, 1834), to which was added a second part, 1835. Revised by Alfred Gudeman.

Friuli, frē-oo'lē [Ital. (whence the Germ. name *Friaul*) < Lat. *Forum Julii*, liter. market-place of Julius]: the name of a territory along the northern and northeastern Adriatic, which in the Middle Ages formed an independent duchy, but which is now divided into the province of Udine, belonging to Italy, and the district of Görz-Gradiska, belonging to Austria. The Friulians speak a Roman dialect (the Friulian) containing Celtic elements. The country is beautiful, exceedingly fertile, and favored with a mild and healthful climate.

Frizell, Joseph Palmer: civil engineer; b. Mar. 13, 1832, at Barford, Quebec; prepared himself for the profession of civil engineering; engaged in the construction of fortifications on the Gulf coast in the civil war in the U. S.; since employed in the public service, the improvement of rivers and harbors, especially in charge of the system of reservoirs on the head waters of the Mississippi; chief engineer of the board of public works of Austin, Texas, 1890; member of the American Society of Civil Engineers since 1883.

Fro'ben, Johann (*Frobenius*): a learned printer; b. at Hammelburg, in Franconia, in 1460. He received his education at the University of Basel, then served as corrector under Amerbach and Petri until 1491, when he established his own printing-office in Basel. His first publication was a Latin Bible, and he is said to have been the first, or among the first, to introduce into Germany the use of Roman letters. Froben was a warm friend of Erasmus, and the publisher of many of his works (issued collectively by Jerome Froben, 1540, 8 vols. folio). The advantages offered by the press of Froben and the correctness of his publications, among which was a splendid edition of the *Adagia*, were among the inducements that drew Erasmus from England to settle at Basel 1515. (Drummond's *Life of Erasmus*, vol. i., p. 244.) In this year Froben put to press the first published edition of the Greek text of the New Testament, edited by Erasmus. (*Tregelles on the Printed Text of the Greek Testament*, p. 19.) He undertook, also, under the supervision of Erasmus, the publication of the more important Latin Fathers—e. g. Jerome, on whom Erasmus had bestowed much careful study and labor (1516); Cyprian and Rufinus (1520); Tertullian (1521); Ambrose (1527); Augustine (completed 1528–29). He had intended to supplement these by a similar edition of the Greek Fathers, but he died in Basel before his plans matured (Oct., 1527). His design was, however, carried out by his sons, Jerome and John, and his son-in-law, Nicolas Bischop (Nicolaus Episcopius). Froben's publications, mostly in folio, are noted for their general correctness. The character of the old printer is presented in a pleasing light by Erasmus in one of his letters (*Ep.* dccccxxii.). See Drummond's *Life of Erasmus* (London, 1873, vol. ii., p. 273, *seq.*).

Revised by Alfred Gudeman.

Fro'bisher, Sir Martin: navigator; b. at Doncaster, Yorkshire, about 1535; the first Englishman to sail in search of a northwest passage. After an unsuccessful endeavor for fifteen years to obtain the necessary assistance, he was finally aided in his enterprise by Dudley, Earl of Warwick, and others, and sailed from Deptford in June, 1576, with three vessels of small size. On July 28 Frobisher reached that part of Greenland which he named Meta Incognita, and Aug. 11 passed through the strait to which he gave his name. Among the minerals brought back by him, gold was discovered, and in consequence a second expedition was fitted out, which sailed from Harwich, May 31, 1577; the result of this expedition caused a third to be made in 1578, which, however, arrived so late in the season as to be compelled to return at once. This was the last of Frobisher's voyages. In 1585 he accompanied Sir Francis Drake to the West Indies, and for his services against the Spanish Armada was knighted in 1588. In 1594 he was sent to aid Henry IV. against the Spaniards and Leaguers, and in an attack upon them at Croyzon, near Brest, was mortally wounded, and died at Plymouth, Nov. 7, 1594, soon after having brought back his fleet in safety.

Frobisher Strait: an arm of the sea; in British North America, between Hudson Strait and Northumberland Inlet, extending westerly from the Atlantic Ocean at the entrance of Davis Strait. It is 240 miles long, and has a mean width of 30 miles.

Froebel, frö'bel, Friedrich: educational reformer; b. Apr. 21, 1782, at Oberweissbach, in Thuringia, where his father was the laborious pastor of seven villages. His mother died before his remembrance, and his half orphanage had a prevailing influence on his destiny, giving him a very sad childhood, that quickened his sensibility and stimulated him to reflection, which he manifested by asking strange questions concerning human discords. An affectionate elder brother, to divert his mind from such subjects, undertook to teach him the sexual system of botany, and show him how, by the union of opposites, harmony and beauty gradually grow out of differences. Not long after, being put to school by a maternal uncle, in the first hour of it he heard a discourse by the teacher on the text, "Seek ye first the kingdom of God and his righteousness, and all these things shall be added unto you"; this gave to him the joyful conviction of there being a law which, gradually discovered and intelligently obeyed, would bring peace and harmony into the human universe; and when, in 1792, he heard a rumor rife among the peasantry that the world was coming to an end, he says he did not believe it, because the will of God had not been brought about—a wonderful thought for a child ten years old. At thirteen he was apprenticed to a forester, who taught him wood-lore and mathematics, in which he made great attainments. He studied for a time at Jena and Berlin, where he showed great interest in pedagogical methods. Twice he visited Pestalozzi, and in 1816, in connection with a friend by the name of Middendorf, opened a school at Keilhau. One who was a pupil describes it as a paradise of children, but says that during his stay (from 1816 to 1826) it was in a chronic state of bankruptcy. The plan was to educate the children by putting them at work, and making nature itself, and what they produced artistically by horticulture and their own hands, *their books.* It was while here that Froebel married his first wife and former pupil in mineralogy. They never had children of their own, but she made his school a happy family for the twenty years that she lived with him. But they did not confine themselves to Keilhau, where Middendorf only remained steadily and after the death of Froebel. They had schools in Switzerland at Watersee, Burgdorf, and Willisau. Some time during this interval Froebel went to Göttingen University and studied comparative philology, making himself thoroughly acquainted with Latin, Greek, and Sanskrit, and all to complete his own education for his duties. In 1839 he lost his faithful wife, and it was not till 1840 that he founded his first kindergarten at Brandenburg. Twenty-three years before he had published his first work, *Menschenerziehung* (Human Education), in which may be discerned the seeds of the kindergarten. He there gives the process of human development in the child. But at that time it was his idea that the child until he was seven years old should be exclusively educated by the mother. Later he saw that it was simply impossible for mothers with several children and other family duties to devote themselves to the development, mental as well as moral and physical, of each child, but that from the time children were three years old till seven, it was a relief for both parties to have them gather into companies, to be taken care of for several hours of every day by a kindergartner, thoroughly instructed in the process of development and the method of the kindergarten. (See KINDERGARTEN.) For the next twelve years he devoted himself to the education of kindergartners and the establishment of kindergartens. The last attempt was at Hamburg, where he was invited in 1850. He elaborated the method, and has left it a gospel to childhood, for its principle is that free creativeness is at once the means and end of human education, and begins in spontaneous play, so guarded and guided as to coincide with God's creativeness. He married one of the kindergartners whom he educated, and she kept a kindergarten in Hamburg for twenty years after his death, which took place June 21, 1852, at Rudolstadt, where he had a school for training kindergartners. It was in the course of these last twelve years that he published another most characteristic work, *Die Mütter- und Kose-Lieder* (Mother's Cosseting Songs), illustrated by plates and notes addressed to the mother, interpreting to her her instincts, and giving her hints for her motherly prattle with her little children. The reform of education begun by Rousseau, and carried on by Fichte, Pestalozzi, and Diesterweg, finally culminated in Froebel's discovery of the method, as well as principle, of educating the human being in its first years purely by means of its own spontaneous activities. See *Autobiography* (London, 1886); Joseph Payne's *Lectures on the History of Education* (new ed. 1892); Williams's *History of Education* (1892); Marenholz-Bülow, *Reminiscences of Frederick Froebel*, translated by Mrs. Horace Mann; *The Education of Man*, by Friedrich Froebel, International Education Series; H. Courthope Bowen, *Froebel and Education by Self-activity* (1893).

ELIZABETH P. PEABODY.

Froebel, JULIUS: German publicist; nephew of Friedrich; b. in Griesheim, Germany, July 16, 1805; studied at Jena and Berlin; held professorships of mineralogy and other sciences at the University of Zurich 1833–44; edited a radical political paper; removed to Prussia, but was obliged to go to Dresden for political reasons, and his pamphlets on public affairs were suppressed; took part in the revolution of 1848, and entered the Frankfort Parliament; was arrested and tried for a political offense at Vienna, but escaped conviction; removed to Switzerland, and thence to the U. S.; was editor, newspaper correspondent, lecturer, and merchant in New York, Nicaragua, Northern Mexico, and California; in 1857 went to Germany, and became again involved with the authorities; removed to London; became in 1862 an editor in Vienna; and in 1867 founded a journal in Munich; German consul at Smyrna 1873–76, and in Algiers 1876–91. Author of *Grundzüge eines Systems der Krystallologie* (1843); *System der Sozialen Politik* (2 vols., 1847); 2 vols. of American travels (1857–58); *Theorie der Politik* (2 vols., 1861–64); *Die Wirthschaft des Menschengeschlechts* (3 vols., 1870–76), and other works. D. in Zurich, Nov. 7, 1893.

Frog [M. Eng. *Frogge* < O. Eng. *frogga*. Connection with O. Eng. *frox*, *frosc, frog : O. H. Germ. *frosc* > Mod. Germ. *Frosch* : Icel. *froskr*, and with O. Eng. *frocca*, frog : Icel. *fraukr* is not understood]: any one of many leaping tailless Batrachians. The frogs are the typical representatives at once of a class (the Batrachians or Amphibians) and an order (the *Anura* or *Salientia*), and are divisible into several distinct families and numerous genera and species. As representatives of the family *Ranidæ*, the true frogs are distinguished by a peculiar sternal apparatus, the manubrium being a robust bony style, the xiphisternum generally similar, and the arciform cartilages wanting; the skull has no fronto-parietal fontanel; there are no teeth on the lower jaw; the tongue has a broad free margin, is attached in front and free behind, and is more or less deeply notched behind; the ear is perfectly developed, the tympanum, cavum tympani, and Eustachian tubes being present; there are no parotoid glands. The family is represented by a number of genera, the largest of which is that of the typical frogs (*Rana*), of which there are about forty species, found in almost all portions of the world except Australasia and South America.* (For metamorphoses of frog, see cut in article BATRACHIA; see also EVOLUTION.) Nearly a dozen are found in the U. S.: the best known are—1, the common bull-frog (*Rana catesbiana*); 2, the shad-frog (*Rana virescens*); 3, the wood-frog (*Rana sylvatica*); 4, the marsh-frog (*Rana palustris*); and 5, the spring-frog (*Rana clamata*). (1) Much the

The common European frog (*Rana temporaria*).

largest of these, and only rivaled in size by a species (*Rana tigrina*) of the East Indies, is the bull-frog. This, like its fellows, feeds upon worms, mollusks, and insects, and it is said that to those in the Zoölogical Gardens of London are sometimes given sparrows, which they greedily devour; its color is green, bronzed with olive, and with dusky blotches. (2) The shad-frog is recognizable by its eye-like spots, which are dark brown bordered with yellow, and in allusion to which it is also called leopard-frog; the name shad-frog has been derived from its appearing in spring nearly at the same time as the shad. (3) The wood-frog may be known by its reddish-brown color, and by a dark bridle-like stripe passing from the snout and through the eye backward; it is most abundant in woods, and is very closely related to or identical with the *Rana temporaria* of Europe. (4) The marsh-frog has about four to six rows of quadrate dark spots on the back and sides, and is also called the tiger or pickerel frog. (5) The spring-frog, or green frog, is of a bright green

* A single species of *Rana* only is found in South America.

color, with a yellow throat and with a very large tympanum; it is one of the most common species, and one of the most esteemed as a delicacy for the table. Although not universally popular, there is an increased tendency to the appreciation of the frog as a delicacy for the table in the U. S., as there has long been in France; and in most of the large cities frogs can be obtained in proper season. The abhorrence which is sometimes expressed respecting the use of frogs' flesh for the table is due only to irrational prejudices, for it certainly is a most tender and delicate morsel. In France, as is well known, as well as in Southern Europe, it is generally a favorite article of diet, and forms the object of an extended industry. Froggeries abound in which the animals are raised and kept. In the materia medica frogs' flesh was at one time quite popular among European physicians as an antiscorbutic. The common frogs have long been favorite subjects for experimentation among physiologists from the fact that the great vitality of their tissues renders them favorable objects for investigation. They are also celebrated in connection with the history of galvanism, Galvani having been led to his discovery by the consideration of the phenomena exhibited by them when experimenting with the common European species. THEODORE GILL.

Frog: the device used on a railway track where one rail crosses another, so named from its resemblance to the "frog" in a horse's hoof. Frogs were formerly made of cast iron, but now steel rails suitably connected together are generally used. The "plate-frog" has the rails riveted to an iron plate placed beneath them. The "bolted frog" is one in which the rails are connected by bolts passing through the webs, the spaces between the rails being filled by cast-iron fillers. The "keyed frog," shown in the illustration, has the rails held together by clamps, which can be tightened by keys or wedges. The "number of a frog" is the ratio of the length of the pointed part to the width of its base, and for general use on turnouts Nos. 6, 8, and 10 are used. A "spring frog" has the point held against the wing of the main track rail by a spring, thus preventing the jolt caused by the wheel in striking it; when a train passes on to the turnout the flanges of the wheels crowd the point aside, and then the spring restores it to its normal position. A spring frog is usually more durable than a stiff one, and produces less wear on the wheels. "Crossing-frogs" are used where the tracks cross each other, and where the angle is large it is usual to have an inner rail running around the quadrilateral to serve as a guard-rail and give extra stiffness. See Parson's *Track*, 1886.

MANSFIELD MERRIMAN.

Frog: a part of a horse's hoof. See FARRIERY.

Frogfish: See ANGLER.

Frog-spawn: properly the name of the gelatinous mass inclosing the ova of frogs; but the name is extended in rural districts to some of the large green fresh-water Algæ, which form slimy masses in streams and ditches—notably to those of the family *Batrachospermaceæ*, of which *Batrachospermum moniliforme* is a very common species both in Europe and the U. S.

Frog-spittle, **Cuckoo-spit**, or **Toad-spit**: a frothy substance often seen on grasses, weeds, and even trees, closely resembling human saliva in appearance. On examination it will be found to contain one or more grubs, the larvæ of various leaf-hoppers—insects of various families of the *Hemiptera*. In Europe the larvæ of *Cicada spumosa* is a very common cause. In the U. S. the genera *Heleochara* and *Aphrophora* are among the froth-producers. This froth consists of the sap of the plant. These insects are great pests to vegetation, and very numerous in species.

Froissart, frwaă'saar', JEAN: author; b. at Valenciennes, France, in 1337; was destined by his father for the Church, and took holy orders; went to England; was (1361–66) secretary and chapel-clerk to Queen Philippa, wife of Edward III., a liberal patroness. He traveled at her suggestion, that he might collect materials for chronicles, much in Flanders, France, Scotland, Italy, and other countries; became canon of Chimay 1390. The time of his death is not known, but probably was prior to 1419; the place was probably Chimay, in Belgium. He compiled for the Duke of Brabant a collection of ballads and songs called *Meliador*, but is chiefly memorable for his immortal *Chronicles*, the most important written historical monument of the Middle Ages in existence. Froissart's *Chronicles* are of great value, but are not so much an accurate history as a faithful picture of his times, and of their places, customs, and people. They range over all Western Europe, for Froissart, a churchman and scholar, living in unsettled times before the feeling of nationality had been well developed, is quite destitute of patriotic feeling. The favorite English version of this fine old author is that of Thomas Johnes (1803–10, 5 vols. 4to, often reprinted—e. g. 1884, 2 vols. 8vo), but the old translation by J. Bourchier, Lord Berners (1523–25, 2 vols. fol.), is correct and much more spirited. Buchon's edition (1824–26, 15 vols.) is the best of the original French text. The best edition of the original text of the *Chronicles* is by Luce (Paris, 1869–88, 8 vols.).

Frölich, frö'lich, LORENTZ: a Danish figure-painter; b. in Copenhagen, Oct. 25, 1820. His etchings *Amor and Psyche* and his *Lord's Prayer* are popular throughout Europe, and have appeared in many editions in London and Paris. His numerous illustrated books for children have also given him a European reputation. He illustrated Hans Christian Andersen's works, and has made an extensive series of etchings illustrating Scandinavian mythology.

R. B. ANDERSON.

Frome: town of Somersetshire, England; on the Frome; 12 miles S. of Bath (see map of England, ref. 12–G). It has considerable manufactures of broadcloth and cassimeres. Pop. (1891) 9,613.

Fromentin, frō'maań'tăń', EUGÈNE: painter of genre and Oriental scenes; b. in La Rochelle, France, Oct. 24, 1820. Pupil of Remond and Cabat; first-class medal, Salon, 1859; officer Legion of Honor 1869. His pictures are remarkably fine in color, and his drawing of horses is excellent. He wrote charmingly and with the most admirable critical knowledge on art subjects. His *Les Maîtres d'Autrefois* is a book on painting which can not be too highly praised, and his *Un Été dans le Sahara* is a delightful book of travels. *Algerian Falconer* (1873) and *Arab Encampment* (his last work and unfinished) are in the Louvre. Many of his best works are in the U. S.: *Crossing the Ford* and *Arabs Watering Horses*, collection of Mrs. William H. Vanderbilt, New York; *Encampment in Atlas Mountains*, collection of W. T. Walters, Baltimore. D. at St.-Maurice (near La Rochelle), Aug. 27, 1876. WILLIAM A. COFFIN.

Fronde [Fr., liter., a sling (the name being applied as a reproach, in allusion to the use of the sling by the street-boys of Paris) < Lat. *funda*, sling]: a faction of French nobles who opposed Cardinal Mazarin during a part of the minority of Louis XIV. The breaking up of the feudal system by Richelieu had finally led to a centralized despotism, against which the Parliament of Paris was the first to rise, offering a determined opposition. It refused to register the royal edicts; and when compelled by the king to register, the populace rose in its defense, Aug. 27, 1648—*la journée des barricades*. In the October following the popular demands were acceded to, but the malcontent nobles seized the opportunity of trying to overthrow Mazarin and to regain their old power—the Princes of Condé and Conti, the Dukes of Longueville, Beaufort, Orleans, Bouillon, Vendôme, Nemours, etc. The struggle lasted from 1649 until 1652, and as far as military results were concerned was favorable to the nobles, who had the grandest opportunities for making a great constitutional reform; but as they had no strong leadership, no fixed principles, and no definite object except self-aggrandizement, Mazarin in 1653 snatched from his mutually jealous and strangely frivolous enemies the fruits of their victory. The war of the Fronde was one of the most ridiculous and useless contests in history. See *Les Mazarinades*, a large collection of lampoons on the court; Saint-Aulaire, *Hist. de la Fronde* (1841); the histories of Barante and Fitzpatrick; Cousin, *La Fronde en Paris.*

Frontal Bone [*frontal* is from Mod. Lat. *fronta'lis*, deriv. of Lat. *frons*, *frontis*, forehead]: in the vertebrate skeleton, one of the most important bones of the skull. It is regarded as representing the neural spine of the second cephalic vertebra. In man it has two parts, a vertical and an orbito-nasal portion, the former the bony portion of the forehead, the latter forming part of the roof of the orbits of the eyes. It is developed from two centers, and at birth is divided vertically into two lateral halves by the frontal suture, which sometimes persists through adult life. The vertical part consists of an outer and inner hard layer, separated to some extent by a diploë, a soft cancelous tissue furnished with large veins. Just above the eyes the diploë is wanting, and its place is occupied by the frontal sinus, a cavity in two parts, each of which communicates with the nasal passages.

Frontenac, frōn'te-naăk', LOUIS DE BUADE, Comte de: soldier and governor of the province of New France; b. in 1620 in France; served in the army in Italy, Flanders, Germany, and received many wounds; in 1672 was appointed Governor-General of Canada by Louis XIV., having already won a wide renown for valor. He was a relative of Madame Maintenon and the husband of a court beauty who used her influence against him. His first governorship of New France (1672–82) was marked by the building of Fort Frontenac (now Kingston, Ontario) and the expeditions of La Salle, Marquette, and Joliet; but Frontenac, a man of great abilities, was hampered by the action of his intendant and of Laval, Bishop of Quebec, so long the virtual ruler of Canada. He was accordingly recalled, but in 1689, Canada being almost ruined under his successors, he was sent out again. He now punished the Iroquois, destroyed, through his lieutenants, the English fleet in Hudson's Bay, ravaged Newfoundland, terrified all the English-speaking coast-towns as far south as New Jersey, captured Pemaquid, Casco, Salmon Falls, Schenectady, and in 1690 repulsed the forces of Phips before Quebec—an event which Louis XIV. commemorated with a medal. His courage and his activity were marvelous, and he actually succeeded in restoring for a time the fallen fortunes of France in America. This able soldier died at Quebec, Nov. 28, 1698. See Parkman, *Count Frontenac and New France under Louis XIV.* (Boston, 1877).

Frontier: in general, the boundary that separates contiguous states; in a more restricted sense, employed especially in the U. S., the term indicates those outlying regions which at different stages of the country's development have been but imperfectly settled, and have constituted the meeting-ground of savagery and civilization.

The consideration of frontiers in the former and more common acceptation of the term has given rise to important questions of political science which have been answered in various ways at different periods of the world's history, and in Europe, where densely populated states abut on each other, the subject of boundaries has always been one of special significance. Publicists have discussed the questions whether there are "natural frontiers" within which a nation should restrain its activity; how the lines are to be drawn along rivers, lakes, straits, and mountains marking the frontiers; how changes of these natural boundaries affect the respective states; and whether frontiers should correspond rather with race boundaries than with "natural frontiers." The growth of the spirit of nationality, the distinguishing feature of modern political history, has tended to lessen somewhat the importance of physical lines of demarkation as compared with racial boundaries, thus sacrificing in many instances the geographic unity of a state to its ethnic unity. The same spirit, moreover, has striven steadily against the attempts of the powers to mark the frontiers in accordance with dynastic interests to the disregard of the racial unity of their subjects or citizens. Even the Congress of Vienna in 1814–15, with its excessive respect for the theory of legitimacy, reveals in many of its territorial arrangements the strength of the principle of nationality in determining the proper frontiers; and subsequent readjustments of the map of Europe have proved that this principle has been steadily gaining ground. The modification of means of intercourse and of the arts of war has diminished the importance of former natural frontiers from the point of view of offense and defense; and the enunciation of the doctrine that the state should coincide with racial rather than with topographic boundaries has afforded at least a pretext for ignoring old-time division-lines. But in any case it is desirable to have a definitely marked physiographic frontier instead of an artificial boundary-line. As a general principle it may be said that wherever a given population have an essential unity of interests, whether arising from topographic facts, race identity, or social and economic considerations, there is a strong tendency to political unity; therefore the "natural frontier" is that which bounds a people of fundamentally identical interests.

Writers on international law have laid down the principle that when the frontier of a state is formed by a natural water-barrier, not marked by a definite line along this barrier, the gradual accretions from fluvial deposit accrue to the state along whose boundary they form. But when a river or lake suddenly transfers its channel entirely within the territory of one of the states bounded by it, the boundary remains along the former river-bed. Publicists have also declared that where a boundary follows mountains or hills the water-divide constitutes the frontier. Where it follows a river, the boundary is determined by a line running through the middle or along the center of the deepest channel of navigable streams, provided there is no positive proof that the entire river-bed belongs to either of the contiguous states. The same principle applies to lakes. See Hall, *International Law*, §§ 37–38.

In the U. S. the frontier is not a fortified boundary-line separating populous States, but by common usage implies the outskirts of civilization, the regions but partially reclaimed from savagery by the pioneer. In the reports of the U. S. census the frontier-line has been defined as the inland line limiting the area which has an average, county by county, of two or more inhabitants to the square mile. This area is called the settled area. Between this census frontier-line and the Indian country the belt of territory sparsely occupied by Indian traders, hunters, miners, ranchmen, backwoodsmen, and adventurers of all sorts, constitutes the traditional frontier. In the course of American history the frontier has been advanced steadily westward, and in its advance settlement has also widened out N. and S. along its flanks. The continuity of the settlement has been broken by passing over certain regions which have remained to be occupied later; thus the less desirable regions of the Appalachian Mountains and of the Rocky Mountains were left isolated, and regions occupied by Indians, as well as the Great Plains, were left behind the general advance. In this advance of the frontier successive waves of industrial life have crossed the continent, and these waves have corresponded to the stages of the economic progress of society. The Indian traders and hunters, exploiting the fur-bearing animals, worked their way from the Atlantic coast along the rivers and lakes, until as early as 1830 they were traversing the passes of the Rocky Mountains, while the farmers were still near the mouth of the Missouri. The hunter life was followed by the pastoral life of the cattle-raiser, or in the mountainous regions by the miner's activity. The pioneer farmers (whose earliest representatives merged with the previously mentioned classes) came next and cleared the land and used up the virgin soil of the prairies with unrotated crops and careless farming.

Statistics for determining the settled area in the colonial period are lacking, but at the date of the first census in 1790 the settled area was bounded by a line which ran near the coast of Maine and included New England, except a portion of Vermont and New Hampshire, New York along the Hudson and up the Mohawk for some distance, Eastern and Southern Pennsylvania, Virginia, well across the Great Valley, and the Carolinas and Eastern Georgia.

By the census of 1820 the settled area included Ohio, Southern Indiana and Illinois, Southeastern Missouri, and about half of Louisiana. The continuity of this area was interrupted by Indian tribes, the management of which now came to be an important question. The frontier region of the time lay along the Great Lakes, where Astor's company operated in the Indian trade, and beyond the Mississippi, where the Indian trade extended to the Rocky Mountains, and in the Florida country. The Mississippi was the scene of typical frontier settlements. By the middle of the century the Indian region proper lay along the eastern boundary of what is now the Indian Territory, Nebraska, and Kansas. Minnesota was still a region of frontier conditions; but for the most typical frontier conditions at this period one must look to the settlements of California, where the gold discoveries had sent a sudden tide of adventurous miners to the Oregon territory and to the Mormon settlements in Utah. As the advance of the frontiersman beyond the Alleghanies had caused the rise of important questions of transportation and internal improvement, so now the settlements beyond the Rocky Mountains needed means of communication with the East. Accompanying the creation of these arose the settlement of the region of the Great Plains and the development of still another kind of frontier life. Railroads fostered by land grants sent an increasing tide of immigrants into the far West, the U. S. army fought a series of decisive Indian wars in Minnesota, Dakota, and the Indian Territory. By 1880 the settled area had been pushed into Northern Michigan, Wisconsin, and Minnesota, along Dakota rivers and in the Black Hills region, and up the rivers of Kansas and Nebraska. The development of mines in Colorado had sent isolated frontier settlements into that region, and Montana and Idaho as well were being settled. The superintendent of the census for 1890 reports that the settlements of the West lie so scattered throughout the entire region that there can no longer be said to be a frontier-line.

The hardships of frontier life conduced to an energetic and self-reliant spirit among the pioneers which has had a great influence upon the national life and character. In spite of the lawlessness that has marked these border communities, the necessary result of the rude conditions surrounding them, this influence has had no small share in developing the practical ability and inventiveness of the people. F. J. TURNER.

Fronti'nus, SEXTUS JULIUS: a Roman writer, distinguished also in civil and military affairs; was b. about 40 A. D., though the exact year is not known. His first appearance in public life was as *prætor urbanus* in A. D. 70, under Vespasian. Tacitus, in his *Life of Agricola*, tells us that he was appointed to the chief command in Britain (76–78), and that he conducted himself with ability, subduing the warlike tribe of the Silures. He was succeeded by Agricola, and on his return to Rome escaped the suspicions and jealousy of Domitian by living a retired and studious life. He was twice honored with the office of consul, and in A. D. 97 was appointed by Nerva *curator aquarum* (superintendent of aqueducts), to which appointment no doubt we owe his most valuable publication. He died probably in 103. Frontinus has left a work on military tactics, presented in the form of a series of anecdotes of distinguished kings and commanders, entitled *Strategematon libri III.* To each of the three books a brief preface is prefixed, detailing the chief subject of the book. A fourth book was added later by some unknown writer. More important than this is the other extant work of Frontinus, *De Aquis urbis Romæ liber*, in which he describes the construction and maintenance of those vast and expensive structures which made Rome enviable among ancient cities for its ample water-supply. Besides these, several treatises on land-measurement are ascribed to Frontinus, fragments of which are contained in the collection of Agrimensores, or *Rei Agrariæ Auctores*, by Goesius (Amsterdam, 1674, 4to), and in *Gromatici Scriptores*, by Lachmann and Rudorff (2 vols., Berlin, 1840–52). The best editions of the *Strategemata* are those of Oudendorp (Leyden, 1731, and again 1779); G. Gundermann (Leipzig, 1888); of the *De Aquæ ductibus*, those of Polenus (Padua, 1722, 4to); Dederich, with German translation (Wesel, 1841); and of F. Buecheler (Leipzig, 1858). See also R. Lanciani, *Topografia di Roma antica, i commentari di frontino intorno le acque, etc., silloge epigrafica aquaria* (Rome, 1881); a new recension of the text of both works by Dederich (Leipzig, 1855). Revised by M. WARREN.

Frontlet: See PHYLACTERIES.

Fron'to, MARCUS CORNELIUS: public speaker and rhetorician; b. at Cirta, Africa, about 100 A. D. Having removed to Rome, he soon attained high distinction as a teacher of eloquence, and won the special favor of the Emperor Hadrian, and Antoninus Pius, by whom he was intrusted with the education of the imperial princes, M. Aurelius and L. Verus. In 143 he held for a short time the office of consul, but he declined, on the plea of ill-health, the charge of a proconsular province. He was held in high honor by his contemporaries, and ranked among the most distinguished orators. He even had a body of followers, who took him as their model, and were called after him, *Frontoniani*. The date of his death is uncertain. It must have been as late as 175. Until 1815 no remains of Fronto were known to exist, except a doubtful treatise, *De nominum verborumque differentiis*. But in that year Mai discovered in the Ambrosian Library at Milan a palimpsest MS. which contained a number of the letters of Fronto, which he published. Subsequently, being transferred to the Vatican in Rome, Mai discovered there more than a hundred additional letters, a portion of the correspondence of Fronto with the Emperor Antoninus Pius and with his former pupils, Marcus Aurelius and Lucius Verus. He issued a new edition of his work, in which these were incorporated (Rome, 1823; reprinted 1846). A complete edition of the correspondence of Fronto, founded on a new recension of the MSS., was published by S. A. Naber (Leipzig, 1867). Revised by M. WARREN.

Froschweiler: See WÖRTH.

Frossard, frō'saar', CHARLES AUGUSTE: French general; b. Apr. 26, 1807; educated at the École Polytechnique in Paris, and at the school of artillery and engineering in Metz; entered the army Oct. 1, 1827; distinguished himself in Algeria; took part in the siege of Rome in 1849; in Jan., 1855, received the command of the Second Engineer-corps of the Crimean army; conducted the engineering operations for reducing the Malakoff; received, after the fall of Sebastopol, the cross of a commander of the Legion of Honor. In the Italian war in 1859 he was chief of the whole engineering department, and after the war he received the grand cross of the Legion of Honor. After this active and successful career Frossard had the misfortune in the war against Germany (1870–71), as commander of the Second Army-corps, first to arrange the attack on Saarbrücken (Aug. 2, 1870), and then to be thoroughly beaten out of the place on Aug. 6. He led his corps back to Metz, and participated in the battles of Vionville and Gravelotte (Aug. 16 and 18, 1870). On the capitulation of Metz (Oct. 27, 1870) he fell into German captivity. Author of *Rapport sur les opérations du deuxième corps de l'armée du Rhin dans la campagne de 1870* (Paris, 1871). D. Sept. 3, 1875.
Revised by C. K. ADAMS.

Frost [M. Eng. *frost, forst* < O. Eng. *forst, frost*: Icel. *frost*: O. H. Germ. *frost* < Mod. Germ. *Frost* < Teuton. **frustas*, deriv. of *frius-, fraus-, frus-*, freeze. See FREEZING]: properly, frozen dew, rime, or hoar-frost, often called *white frost*, to distinguish it from *black frost*, which is the effect produced upon herbs and leaves by the freezing of their juices. The freezing of soil-moisture is popularly called frost also. Hoar-frost is a deposit of minute ice-crystals in the place of dew. The conditions for the formation of white frost are precisely those requisite for the formation of dew (see DEW), except that those conditions (radiation of heat, etc.) act at lower temperatures. The presence of considerable bodies of water diminishes frost powerfully, because water by day absorbs and by night radiates much heat. Thus Western Michigan is rendered a good peach-region by the west winds, tempered by the influence of Lake Michigan. Thick clouds, or a dense smoke, will act as a blanket over the earth, and diminish or prevent the deposit of frost, and even a thin layer of smoke may be effective. The fact that low lands are usually visited by frost much earlier in the autumn and later in the spring than the neighboring hill lands is due to the fact that the colder air settles down upon the low grounds, and the hills are more exposed to the winds, which tend to prevent the stagnation of the air. The hygienic effect of frost is generally salutary. Malarial fevers are favorably modified by it, and the spread of cholera and of yellow fever is usually checked at once. Some forms of milk-sickness in cows are, however, attributed to feeding upon forage which has been touched by black frost. Frosts are successfully predicted by the weather bureau, to the great advantage of the growers of delicate crops. Revised by M. W. HARRINGTON.

Frost-bite and Freezing: conditions caused by the action of cold upon the animal economy. Frost-bite is local and partial—freezing is general and more or less complete. Severe frost-bite may lead to gangrene, but the milder forms often result in nothing worse than chilblains, which are very annoying, but not often dangerous. General freezing, if rapid, may result in speedy death; but more frequently the vital functions pass for a time into a state of abeyance, which may last, it is said, for some days, and then be terminated by death. In recovering frozen and unconscious persons it is held that a very slow restoration of the normal temperature is safest, apparently because sudden warmth arouses those dormant energies which demand immediate aëration of the blood, which failing, death at once ensues. It is, however, suggested that very rapid warming might, in many cases, secure all the advantages of slow restoration of temperature, and experiments on some of the lower animals seem to favor this idea. The belief that alcoholic drinks taken before exposure protect against cold is entirely erroneous, since by producing activity of circulation and dilatation of the blood-vessels of the skin, they favor rapid loss of heat, and therefore hasten freezing.
Revised by WILLIAM PEPPER.

Frostburg: town; on railway; Allegany co., Md. (for location of county, see map of Maryland, ref. 1–B); situated on a plateau between Savage and Dan's mountains, 1,255 feet above Cumberland and 1,792 feet above tide, immediately over the great coal-basin of Western Maryland; 17

miles W. of Cumberland. It has foundries and a fire-brick manufactory. Pop. (1890) 3,804 ; (1900) 5,274.

Froth Fly: See FROG-SPITTLE.

Frothingham, froth'ing-am, ELLEN: translator; daughter of Nathaniel Langdon Frothingham; b. in Boston, Mar. 25, 1835; devoted herself to the study of the German literature and language. She has inherited her father's literary taste and talent, and has distinguished herself by remarkably fine translations of three difficult masterpieces—Lessing's *Nathan der Weise* (1868), Goethe's *Hermann und Dorothea* (1870), in verse, and Lessing's *Laokoon* (1874).

Frothingham, NATHANIEL LANGDON: clergyman and author; b. in Boston, Mass., July 23, 1793; graduated at Harvard in 1812; in 1812 received the appointment of teacher of rhetoric and oratory at Harvard; prepared for the ministry, and from 1815 to 1850 was pastor of the First church in Boston. He published *Sermons in the Order of a Twelvemonth* (1852); two volumes of *Metrical Pieces* (1855–70); and contributed to literature poetical translations from the Greek, Latin, Italian, and German. He was one of the earliest students of German in the U. S. D. in Boston, Apr. 4, 1870.

Frothingham, OCTAVIUS BROOKS: author; third son of Nathaniel L. Frothingham; b. in Boston, Nov. 26, 1822; educated at the Latin School; graduated at Harvard in 1843; studied theology at Cambridge; was settled in Salem, Mass., Mar. 10, 1847; removed to Jersey City, N. J., in Apr., 1855; in 1859 went to New York and established the Third Unitarian Society, of which he was many years pastor. Mr Frothingham belonged to the extreme left or radical wing of the Unitarians for a time, but finally assumed the attitude of an independent preacher and drew to himself the largest congregation in New York. For several years from its beginning he was president of the Free Religious Association, of which he was one of the founders in 1867. Mr. Frothingham is the author of many valuable books, including *Stories from the Lips of the Teacher* (1863); *Stories of the Patriarchs* (1864); *A Child's Book of Religion* (1866); *The Religion of Humanity* (1873); *The Life of Theodore Parker* (1874); *Transcendentalism in New England* (1876); *Gerrit Smith, a Biography* (1878); *The Cradle of the Christ* (1877); *Beliefs of the Unbelievers*; *The Safest Creed*, a volume of discourses (1874); *George Ripley*, in American Men of Letters (1882); *Memoir of William Henry Channing* (1886); *Boston Unitarianism*, including a memoir of his father, Dr. N. L. Frothingham (1890); *Recollections and Impressions* (1891). In 1889 he published a *Memoir* of Rev. David A. Wasson, with selections from his sermons. For a year he was art-critic for the New York *Tribune*; for several years a regular contributor to *The Index*, an organ of free religion printed in Boston. In 1879 he was obliged by failing health to give up preaching. D. in Boston, Nov. 27, 1895. J. W. CHADWICK.

Froude, frood, JAMES ANTHONY, LL. D.: historian; b. at Dartington, England, Apr. 23, 1818; educated at Westminster and Oriel College, Oxford, where he graduated with honor; became a fellow of Exeter College 1842; was ordained a deacon in 1845; published *Shadows of the Clouds*, tales (1847), and *Nemesis of Faith* (1848), which were condemned by the authorities of the university, and he, as a consequence, lost an appointment as teacher in Tasmania. In 1850 he began to write for *Fraser's Magazine*, the *Westminster Review*, and other periodicals. His greatest work, *The History of England from the Fall of Wolsey to the Defeat of the Spanish Armada* (12 vols., 1856–70), is remarkable for the brilliancy of its style, for the novel views taken of many of the leading characters who figured during the time of which it treats, and for the abundance of fresh material introduced. In 1869 he was installed rector of the University of St. Andrews. In 1871 he resigned the editorship of *Fraser's Magazine*, and in 1872–73 lectured in the U. S. He has also written *Short Studies on Great Subjects* (1867); a little book on *Calvinism* (St. Andrews, 1871); *The English in Ireland in the Eighteenth Century* (3 vols., 1871–74); *Cæsar, a Sketch* (1879); *Reminiscences of the High Church Revival* (1881); *Reminiscences of Thomas Carlyle* (2 vols., 1881); *Thomas Carlyle: a History of the First Forty Years of his Life* (1882); *Reminiscences of his Irish Journey in 1849* (1882); *Oceana, or England and her Colonies* (1886); *The English in the West Indies, or the Bow of Ulysses* (1888). In 1889 he published *The Two Chiefs of Dunboy*, an Irish romance of the eighteenth century; in 1890, a *Life of Lord Beaconsfield*; in 1891, *The Divorce of Catherine of Aragon*; in 1892, *The Spanish Story of the Armada, and Other Essays*. On the death of Prof. Edward A. Freeman, Mar. 16, 1892, Mr. Froude succeeded him as Regius Professor of History in the University of Oxford. D. at Salcombe, Devonshire, Oct. 20, 1894.

Fructidor [= Fr. *Fructidor*, fruit-month, deriv. of Lat. *fruc'tus*, fruit]: in the French republican calendar of 1792–1806, the twelfth and last month in the year, extending from Aug. 18 to Sept. 16. In the year 5 (1796–97) occurred the "*coup d'état* of the 18th Fructidor" (Sept. 4, 1797), in which Augereau, acting for the majority of the Directory, removed the minority from that body.

Fruits [M. Eng. *fruit*, *frut*, from O. Fr. *fruit* < Lat. *fruc'tus*, proceeds, fruit, liter. enjoying, enjoyment, deriv. of *frui*, *fructus*, enjoy < Indo-Eur. *bhrug-* > Teuton. *bruk-* > Germ. *brauchen*, use; cf. Eng. *brook*, endure]: in a wide sense, are the perfected ovaries of a flowering plant, with proper envelopes. Some fruits, like the strawberry, result from the blending of many ovaries with a fleshy receptacle. In others, as the fig, the fleshy receptacle is hollow, and the whole inflorescence, including many pericarps, is blended in the fruit. Strictly speaking a fruit consists of the seed and its surrounding pericarp, and fruits receive various general names according to the nature of the pericarp; for instance, the achenium, the samara, the drupe, the pome, the berry, the sorosis, the pepo, and many other forms, of which the more important are noticed in this work under their alphabetical heads. For the use of fruits as food, see FOOD.

Fruit-culture: See POMOLOGY, NURSERY, and the articles dealing with the different fruits.

Frumen'tius, SAINT: a Christian missionary of the fourth century; b. in Phœnicia. Rufinus, his biographer, says that he was captured by the Abyssinians while traveling in their country in company with his kinsman, a Tyrian philosopher, who was murdered by them. Frumentius was taken to the court, where he ultimately became tutor to the young prince, on whose succession he returned home. Consecrated bishop by Athanasius at Alexandria, he again went to Abyssinia, where he became the recognized founder and apostle of the Abyssinian Church.

Fry, Sir EDWARD: See the Appendix.

Fry, ELIZABETH: philanthropist; daughter of John Gurney, and wife of Joseph Fry, of London; b. at Erlham, Norfolk, England, May 21, 1780; was brought up a Friend, and under the ministrations of William Savery, an American Quaker, in 1798 became awakened to a new religious life; was married in 1800, and then resumed her former habit of visiting the poor and sick, afterward extending her attention to seamen, prisoners, outcasts, and the vicious classes, not only in London, but in all parts of Great Britain and Ireland, and later even in many continental countries. In 1809 she became an occasional preacher, and notwithstanding the great extent, importance, and success of her benevolent labors, she found time to train with care and thoroughness a large family of her own. It is in connection with her prison work that she is chiefly remembered. Her reading the Scriptures in the woman's prison at Newgate, London, is the scene of a familiar painting. She died at Ramsgate, Oct. 12, 1845. See her *Memoirs*, by Thomas Timpson (London, 1846); by her daughters (1847); by Susanna Corder (1853).

Fry, JAMES B.: U. S. military officer; b. in Carrollton, Greene co., Ill., Feb. 22, 1827; graduated at the U. S. Military Academy 1847; was commissioned as brevet second lieutenant in the Third U. S. Artillery, and joined it in the city of Mexico during the Mexican war; served as assistant instructor of artillery at the Military Academy in 1847, and again in 1853–54, and as adjutant of the Military Academy 1854–59; appointed assistant adjutant-general 1861; chief of staff to Brig.-Gen. McDowell during his campaign of 1861, taking part in the first battle of Bull Run; as chief of staff to Maj.-Gen. Buell in 1861–62, took part in the battle of Shiloh, the advance upon and siege of Corinth, the operations in Northern Alabama, and the battle of Perryville; provost marshal-general of the U. S. (brigadier-general) from 1863 to 1866 under the Enrollment Act of 1863, passed to enforce military service after the system of voluntary enlistment had proved inadequate. As provost marshal-general he put into the army by conscription, substitution, and voluntary enlistment 1,120,621 men; arrested and returned to the army 76,562 deserters; made an exact enrollment of the national forces, showing that there remained in the U. S. liable to conscription, but not called out, 2,254,063 men; and collected, under a money-commutation clause of the Enrollment Act, $26,366,316.78. His *Final Report of the Operations of the Bureau of the Provost Marshal-General of the United States, from the commencement of the business, Mar. 17, 1863, until the Bureau terminated by law, Aug. 28, 1866*, is published as a congressional document. Promoted through various grades to lieutenant-colonel in the adjutant-general's department and brevet major-general U. S. army; served from 1866 as adjutant-general of the military divisions of the Pacific, the South, and the Atlantic. He was retired in 1881. Author of *The History of Brevets, The Army under Buell*, and of various pamphlets on military subjects. D. in Newport, R. I., July 11, 1894.

Fry, William Henry: composer and journalist; b. in Philadelphia, Aug. 10, 1815. Studied music entirely under local teachers and began composing in early life. In 1845 he produced his opera *Leonora* in Philadelphia and afterward, on Mar. 29, 1858, in New York at the Academy of Music. His second opera, *Notre Dame*, libretto by his brother, J. R. Fry, was produced at Philadelphia a few months before his death, which occurred in Santa Cruz, West Indies, Dec. 21, 1864. He also composed two other operas, several symphonies, which were performed by Jullien's orchestra in New York, several cantatas, and a *Stabat Mater*. For several years he was the music critic on the New York *Tribune*, and he wrote many political, economical, and literary articles for the press.

Frye, William Pierce, LL. D.: U. S. Senator; b. in Lewiston, Me., Sept. 2, 1831; graduated at Bowdoin College in 1850; became a lawyer; was member of Maine Legislature 1861–62 and 1867; mayor of Lewiston 1866–67; attorney-general of Maine 1867–69; elected member of national Republican executive committee in 1872; re-elected 1876 and 1880; was presidential elector in 1864; delegate to national Republican conventions 1872, 1876, and 1880; became chairman of Republican State committee of Maine in 1881; representative in 42d, 43d, 44th, 45th, 46th, and 47th Congresses; was elected U. S. Senator from Maine 1881; re-elected 1883, and again in 1888 and 1895; member of the peace commission 1898.

Fryken, frü'ken: a series of lakes in Sweden extending in a north and south direction over a distance of about 15 miles, and emptying into the Lake of Wenner. They have the appearance of a broad river, and the valley which incloses them presents some of the finest scenery in Sweden; it has been called the Swedish Switzerland.

Fryxell, früks'el, Anders: a celebrated Swedish historian; b. at Hesselskog, Dalecarlia, Feb. 7, 1795, and studied philosophy and theology at the University of Upsala. From 1822 to 1836 he was director of one of the most prominent educational institutions of Stockholm, and in 1824 he wrote a grammar of the Swedish language which is used in all the higher schools of the country. In 1830 he took the prize of the Academy of Stockholm for a dissertation on the history of Sweden from 1592 to 1600. In 1836 he was appointed provost of North Wermland, a position in the Lutheran Church intermediate between minister and bishop, but in 1847 he resigned this office in order to devote himself entirely to historical studies. Fryxell's chief work is *Berättelser ur Svenska Historien* (34 vols.). In the Scandinavian countries this book is much read and highly esteemed, and parts of it have been translated into German and French. Its style is fluent and lively, its narrative brisk and graphic, and as the author has made very extensive studies of archives not only in Sweden, but in Poland, Prussia, and Denmark, his work is exceedingly rich in details at once new and authentic. In his leading views he forms an opposition to Geijer, who may be considered as the historian of the democratic party. The attacks upon the aristocracy by the historians of the democratic school occasioned Fryxell to write his book *Dur aristokrat-fordömandet in Svenska historien* (4 vols., 1845–50), in which he defends the Swedish aristocracy, without defending the crimes it may have committed or the general injustice of its political preponderance. The book gave rise, nevertheless, to a very fierce contest between the two historical schools, which spread from science into politics. D. at Stockholm, Mar. 20, 1881.

Fuad Pasha, foo'ăad-paă-shaa': Turkish statesman; a son of the poet Izzet Molla Kischedji-Zadek; b. at Constantinople in 1814. In 1840 he was secretary to the embassy in London; in 1843 was appointed interpreter in the ministry, and soon afterward sent to the court of Spain on an errand of diplomatic courtesy. In 1848 he was named commissioner-general in the principalities of the Danube. In 1849 he became Minister of the Interior, and from Aug., 1852, to Mar., 1853, from May, 1855, to July, 1857, and in Jan., 1858, he occupied the position of Minister of Foreign Affairs. He participated as a plenipotentiary in the conference at Paris. In 1860 he punished the Druses and Mohammedans for their persecution of the Christians, and in Nov., 1861, was appointed grand vizier. In Feb., 1862, he took charge of the finances, and in Feb., 1867, was appointed Minister of Foreign Affairs for the fourth time, while his friend, Aali Pasha, was appointed grand vizier. Fuad Pasha was a man of French education and tendencies, a great admirer of France and Napoleon III., and the chief support of the reform party in the Turkish empire. D. in Nice, France, Feb. 3, 1869. He wrote a grammar of the Turkish language, which has been translated into several languages.

Fuca, foo'kaă, Juan, de: a Greek navigator whose real name was Apostolos Valerianos, a native of Cephalonia; was many years in the Spanish service, and in 1592 discovered the channel known as the Strait of Juan de Fuca. This he professed to consider a passage joining the Atlantic and Pacific. D. in Zante in 1602.

Fuca'ceæ: See Fucoids and Vegetable Kingdom.

Fu-chow-foo: same as Fuh-chow-foo.

Fuchs, fook*h*s, Ernest, M. D.: ophthalmologist; b. in Vienna, June 14, 1851; educated at University of Vienna; assistant, Vienna Eye Clinic, 1876–81; Professor of Ophthalmology, University of Liège, 1881–86; *id.*, University of Vienna since 1885; author of *Das Sarcom des Uvealtractus* (1882); *Die Ursachen und die Verhütung der Blindheit* (English, French, and Italian translations); *Lehrbuch der Augenheilkunde* (English and French translations).

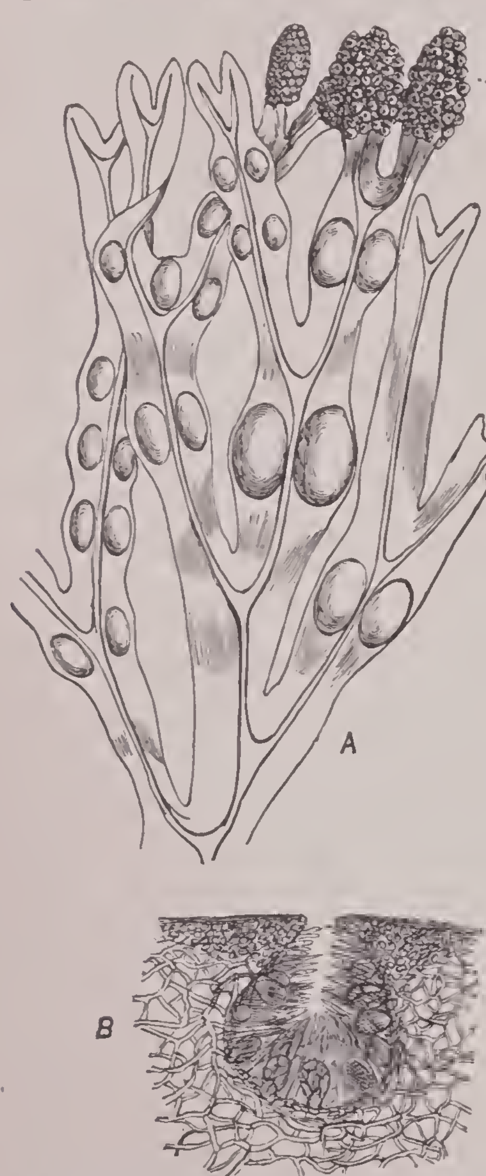
Fuchsia, fyu'shi-a [= Mod. Lat. *fuch'sia*, deriv. of *Fuchs*, a German botanist (1501–1566)]: a genus of dicotyledonous plants, belonging to the natural family *Onagraceæ*. The popular name of the genus is "ear-drop," from the appearance of the pendulous flowers. These are very showy, and of a red, violet, or rose color in their native state. They sport and cross easily, and hence result the numerous varieties known in floriculture. Those with white or cream-colored tints are the most highly prized. The tube of the calyx is showy in appearance, like the corolla, and is extended much beyond the ovary. It is bell-shaped or tubular, with four spreading lobes. The petals are also four in number, and the stamens eight. The style is long and thread-shaped, and surmounted by a club-shaped stigma. The flowers are on axillary peduncles. The plants are mostly smooth, with opposite or whorled leaves. They are either tender shrubs, climbers, or trees, natives of South America as far as Terra del Fuego, and also of the southern parts of North America; and New Zealand has some native species. Their best-known habitat is the Andes of Chili and Peru. The species in cultivation have been so much changed by art that it is often difficult to determine the line of their descent. They may be divided into short and long-flowered and panicled fuchsias. The plant forms a berry which is sweet or only pleasantly acid, and which is eaten in the countries where it is native. A black dye is said to be formed from the wood in Chili. Fuchsias are easily propagated by cuttings. They thrive in a light rich soil. They grow well in the open air in the summer time, but in the northern U. S. have to be housed in winter. There appears to be no limit to the curious freaks of color which they may be made to assume. They bloom best in a rather low temperature, such as is required for roses.

Revised by L. H. Bailey.

Fuchsin, fook'sin: See Aniline Colors.

Fucino, foo-chee'nō, or **Celano**, chā-laa'nō (in Lat. *Fucinus*) **Lake and Tunnel of**: This lake lies about 50 miles eastward of Rome, at the height of 2,200 feet above the sea, in a mountain-basin in the Apennines having no known natural outlet. The ancient and mediæval accounts of the dimensions of Lake Fucino and of the fluctuations of its level are conflicting; but though its waters were undoubtedly partially carried off through natural conduits or fissures or porous strata in the subjacent rock, its depth and superficial extent have at all times been subject to great variation arising chiefly from the varying humidity or dryness of the seasons. In 1810 it covered 42,000 acres, with a maximum depth of $75\frac{1}{2}$ feet; in 1835 its area was but 33,000 acres, its greatest depth 34 feet. The occupation and cultivation of the debatable zone, of about 9,000 acres, between these extremes was of course attended with risk of loss, and at low water the freshly bared soil sent up miasmatic exhalations prejudicial to the healthfulness of the adjacent country. To obviate such evils, and to gain an addition of fertile soil for agricultural purposes by permanently reducing the lowest known level of the lake, Julius Cæsar contemplated the excavation of a tunnel under the mountain-ridge on the western side of the basin to discharge the superfluous water into the river Liris, now called the Garigliano, the bed of which is 62 feet lower than the bottom of the lake. This work was actually commenced by Claudius, and substantially completed after eleven years of labor. The length of the Claudian tunnel was 18,506 feet, or rather more than $3\frac{1}{2}$ miles, with an inclination of about $\frac{1}{1000}$, and a cross-section measuring 102 sq. feet, admitting a delivery of 424 cubic feet to the second. The tunnel was admirably engineered, but poorly constructed, and soon fell into total decay. At various subsequent periods attempts were made to restore the tunnel, but it does not satisfactorily appear that anything was effected until 1852–62, when, by the enterprise and liberality of Prince Alessandro Torlonia, of Rome, the entire line was rebuilt at a cost of more than $6,000,000, and on a far grander scale than that of the ancient imperial work. The new tunnel, which drained the entire lake by 1875, follows the original course, and, though at a somewhat lower level, includes the entire ancient channel, every vestige of the Roman tunnel having been necessarily removed in excavating the new. It is constructed with the utmost solidity, being everywhere lined with a thick revetment of cut stone; its cross-section measures 215 sq. feet, allowing a discharge of 2,400 cubic feet to the second; and, as its axis is lower than that of the Claudian emissary, and the bottom of the lake has been considerably raised in later ages by wash from the shores, the new tunnel is longer than the old by 2,200 feet. Hence its total length falls little short of 4 miles. From the entrance of the emissary a canal 8 miles long and 62 feet wide at bottom, requiring 4,000,000 cubic yards of cutting, was excavated to the deepest part of the lake. See Kramer, *Der Fuciner-See* (4to, Berlin, 1839); Leon de Rotron, *Proscingamento ad Lago Fucino* (8vo, Vienna, 1871)

G. P. MARSH.



A, a branch of *Fucus vesiculosus* (natural size), the fruiting parts at *f*. B, cross-section (enlarged) of a conceptacle.

Fucoids, fyu′-koidz, the *Fucoideæ*, an order of brown seaweeds commonly represented on the coasts of the U. S. by the rockweeds (Fig. A). They are plants of considerable size, ranging from a few inches to several feet in extent, and often show a differentiation into stems and leaves. Their outer tissues are composed of small and closely crowded cells, forming in some cases a hard mass, while the interior cells are loosely arranged, leaving large intercellular spaces.

They reproduce by sexual means only. In the ends of certain branches (see illustration, A, *f*) may be found nearly closed cavities ("conceptacles"), which are lined with hairs, some of which are antherids (producing motile antherozoids), while others produce egg-cells (see illustration, B). The latter when mature are set free by the rupture of the cells containing them, when they float out, where they meet the antherozoids; the latter unite with the egg-cells, and thus transform them into spores, which quickly germinate, and eventually give rise to a new plant.

There are about twenty genera, all of which are included in the single family *Fucaceæ*. The common rockweeds of the coast are species of Fucus and Ascophyllum. The closely related Gulf weed which floats abundantly in the ocean, especially in the Sargasso Sea, is *Sargassum bacciferum*.

The fucoids are all of a brownish or smoky-green color, resembling the KELPS (*q. v.*), which have often been included with them under the same name. Many fossil remains bear the name of "fucoids," although it is often very doubtful whether they were at all related to the plants under consideration.

CHARLES E. BESSEY.

Fucus: See FUCOIDS.

Fuel [M. Eng. *fuel, fowayle*, from O. Fr. *fouailles* < Low Lat. *foca′lium, foca′le*, fuel, deriv. of *focus*, fire = Lat. *focus*, hearth]: any substance which may be used for the generation of heat by its combustion in air. Many chemical reactions evolve heat from factors which are in no proper sense fuels; e. g. lime slaking with water, sulphuric acid mingled with water, quicklime drenched with sulphuric acid, and other like cases, evolve much heat although these substances are wholly incombustible. Properly speaking, only carbon and hydrogen, and the compounds of these two elements with each other, and with oxygen, nitrogen, etc., are fuels. This classification includes all the forms of coal, coke, charcoal, wood, turf, oils of every kind, and combustible gases, such, for example, as escape from artesian borings in oil-bearing and saliferous strata. It excludes sulphur, whether free or evolved from the roasting of ores, although this element is practically utilized as a source of heat in some chemical and metallurgical processes, as in refining sulphur.

Fuels differ very greatly in the amount of volatile matters they contain or which are produced from them in the process of combustion. Thus wood and turf contain a large percentage of free water, which is driven out or evaporated during combustion, while, in common with bituminous coals and lignites, they evolve also a large volume of combustible gases, tar, and other pyrogenic products. Such fuels burn with abundant flame, often with smoke, from imperfect combustion, and are well adapted to the generation of steam, the production of illuminating gas, and are preferred in many metallurgical processes. On the other hand, anthracite coal—of the harder variety—coke, natural or artificial, and charcoal from wood, burn with but little flame and no smoke, evolve little or no watery vapor, and from their firmness under the weight of a load and the high temperature they evolve are specially adapted to smelting iron and other metals, and to the production of a steady, intense, and long-continued heat for any purpose. Fuels also differ much in the amount of ash left by their combustion. In a few cases the ash is less than 1 per cent. of the weight of the fuel (e. g. albertite). The best coal yields 5 per cent. of ash or thereabouts, while many more contain 10 or even 20 and more per cent. of incombustible mineral matter. The presence of foreign matter of an incombustible nature in fuel is a loss of useful effect, not only by reducing the actual amount of carbon, etc., but in that it requires a certain amount of fuel to fuse the ash into a slag, which then encumbers the fire by clinkers. Water is another foreign element which greatly reduces the value of fuels. The common experience of the superior excellence of well-seasoned wood over green or recently cut wood is a familiar example. Water not only impedes combustion by reducing its temperature, but a large amount of heat is removed and rendered useless in converting the water into vapor. Furnaces have been constructed, however, for the purpose of consuming wet fuel, such as tan-bark, bagasse of sugar-cane, etc., in which, by an ingenious arrangement of parts, a high temperature and intense combustion are maintained, even when very wet fuel is used. One of these will be noticed hereafter. Even coal contains some moisture, and the varieties of lignite a much larger amount, while even well-dried wood retains 20 per cent. of water. Fuels containing oxygen also produce water in the act of burning, thus consuming a further quantity of heat. Even the hydrocarbon gases distilled in the combustion of coal are produced at the expense of a certain number of units of heat. It has therefore been asserted—and is often assumed to be true—that the total economical or useful effect of a fuel may be calculated from the known quantity of fixed or non-volatile carbon which it contains. It is, however, demonstrable that this statement, however theoretically correct, is not supported by experiment.

The value of the Pennsylvania anthracite (see ANTHRACITE) over all other coals as an agent for the production of high heats, especially in the high furnace and in the reduction and smelting of metals, is generally admitted. The superior evaporative power of anthracite was first demonstrated by the researches of Prof. Walter R. Johnson in 1844, by an elaborate series of experiments undertaken for the U. S. navy, and published in a *Report to the Navy Department of the United States on the Evaporative Power and other Properties of American Coals* (28th Cong., 1st sess., Senate Doc., pp. 607, 860, Washington, 1844). These researches were not confined to anthracite coals, but were extended also to natural coke, artificial coke, mixtures of anthracite and bituminous coals (Class I.); to free-burning bituminous coals of Maryland and Pennsylvania (Class II.); bituminous coking coals from Eastern coal-field of Virginia, in the neighborhood of Richmond (Class III.); and to foreign bituminous coals and those of similar constitution west of the Alleghany Mountains, and dry pine wood (Class IV.).

The highest evaporative power, as in the production of steam, is not, however, found in anthracite, but in the semi-bituminous coals, like those of Broadtop and the Cumberland region, and the coal of the Cruzot Basin, in which the proportion of hydrogen or volatile hydrocarbon is not greater than can be perfectly consumed in the furnace and flues of steam-boilers. This fact was first demonstrated by the researches of Johnson, and has since been confirmed by those of Sir Henry de la Beche and Dr. Playfair in their report on the coals suited to the steam navy of Great Britain (1848). The latest researches on this subject are those of Messrs. Scheurer-Kestner and Meunier on the coals of Rhenish Prussia and Belgium (abstracted in *Comptes Rendus*, tom. 66–69, and *in extenso* in the *Bulletins de la Société Industrielle de Mulhouse*). The calculations of Mendenhall on the heating powers of some Ohio coals (*Geological Survey of Ohio*, 1870) point in the same direction, as also those of Raymond on the lignites of the West.

BITUMINOUS COAL.—This coal contains a variable quantity of volatile matter, expelled as combustible gases when heated in close vessels, and leaves behind coke of variable strength, according as the coal is treated, and varying also with the amount of volatile matter expelled, and its physical and chemical constitution. Heated at lower temperatures, many of the coals of this class produce hydrocarbon oils, while coal-tar is a product of their destructive distillation at all temperatures, whence the name *bituminous*. When these coals agglutinate to form a hollow fire, they are called caking coals or fat coals. The mass softens and becomes pasty under heat and semi-viscid. This softening takes place below redness at the stage of incipient decomposition, and is attended with the escape of gas, which often blows bubbles, leaving the mass porous, and escapes in jets of smoke and yellow, smoky flame. With a higher heat in close vessels (gas-retorts) the escape of gas ceases gradually, and finally leaves a porous brittle mass of gray-black color and submetallic luster which is coke. The gas expelled in this way from bituminous (gas) coals varies from 25 per cent. to 50 per cent., and in the cannel coals rises even to 60 per cent.; the more common average being about 35 per cent. for gas-coals. The semi-bituminous coals of Pennsylvania and Maryland yield only from 12 to 20 per cent. of volatile matter. The *non-caking* or *free-burning* bituminous coals are like the caking coals in appearance, and often closely resemble them in ultimate composition, but they leave no proper coke. This is the character of the *lignites*, so called, of Colorado and Wyoming, mention of which is made beyond.

CANNEL COAL (*q. v.*) is a fuel of inconstant properties, owing its character, apparently, to local peculiarities of origin. *Torbanite*, *albertite*, *wollongongite*, and *grahamite* are bituminous minerals of exceptional richness in volatile hydrocarbon. The *torbanite*, or "bog-head" cannel, seems like a clay saturated with bituminous matter. It yields over 68 per cent. of gas and nearly 23 per cent. of ash, and only 8·8 of fixed carbon. *Albertite*, on the contrary, leaves only 0·10 per cent. of ash, and is regarded by Dana as an asphaltum, although commercially sold as an enriching coal.

BROWN COAL.—This variety of coal differs from bituminous coal chiefly in containing a larger amount of constitutional oxygen, more combined water, and in being generally more friable. Its powder is distinctly brown and not black, whence its name; but it is sometimes of a pitchy-black color and fine luster. It is found in more recent geological horizons than the coals before named. The deposits of this variety of coal opened in Colorado, Wyoming, and Utah are remarkable for extent, thickness, and uniformity, affording an inexhaustible supply of excellent fuel in a region for the most part destitute of forests and remote from all other sources of fuel-supply. Similar beds are found also in California and elsewhere on the Pacific coast. The brown coals are not caking coals, but are free-burning coals, yielding much gas, and are good steam coals, but not well adapted to carry the burden of the high furnaces for iron, although perfectly well adapted to general metallurgical use and to the Siemens gas furnace.

CHARCOAL AND COKE.—Charcoal prepared from hard woods at a high temperature is the purest form of carbon available as a fuel, being entirely free of sulphur and yielding only a little alkaline ash, with a small amount of silica. Burning to carbonic acid by oxygen, it forms the standard of comparison for the heat evolved by other less pure forms of fuel. By the experiments of Favre and Silbermann it gave per pound of fuel 8,080 calories (C.), equal to 14,544 calories F. Coke is less efficient than charcoal, just in proportion to the amount of ash it leaves, and this is usually about 15 per cent. But owing to its much greater strength under the crushing weight of the high furnace, as well also as its greater cheapness, it is the preferred fuel for the high iron furnace. The sulphur it retains from the pyrites found in the crude coal may be almost completely removed by proper mechanical treatment of the coal before coking. For this purpose the coal is crushed and washed in an apparatus similar to that used in the concentration of metallic ores, by which the pyrites is removed by virtue of its greater density, and the coke prepared from coal so treated is found to yield iron of a very superior quality, owing to its almost complete freedom from sulphur. In the process of coking the fine coal unites into compact prismatic masses, of a submetallic luster, sonorous when struck, like cast iron.

LIQUID FUELS.—The hydrocarbon oils found so abundantly in Pennsylvania and elsewhere, and produced artificially by the distillation of bituminous schists, offer a valuable resource for fuel in certain situations where their abundance enables them to compete with solid fuel. For example, the light naphtha forming from 20 to 25 per cent. of the first product of the distillation of Pennsylvania petroleum is extensively employed in the oil-regions as a steam fuel and for the distillation of the crude oil in its first stages of treatment. For this purpose the naphtha in vapor is burned from jets in wrought-iron pipes arranged beneath large boilers and pierced with numerous fine holes, the supply of air being regulated to secure a complete combustion. The exact value of light naphtha thus used as a source of heat has not apparently been practically determined in comparison with other liquid fuels. But a series of experiments are cited in the *Report of the Commission appointed to Inquire into the Several Matters relating to Coal in the United Kingdom* (1871), in which the materials employed were crude petroleum, crude paraffin oil, dead oil or creosote, and their calorific power and evaporative efficacy, determined by trials in the large way under steam-boilers, as compared with coal, under the direction of Prof. W. J. Macquorn Rankine. The results are as follows:

FOR ONE POUND OF—	Total quantity of heat generated.	Quantity of heat available for producing steam.	Quantity of water heated from 60° to 212° F., and converted into steam at 212° F.	Temperature of the fire or flame.
	Heat-units.	Heat-units.	Lb.	F.
Crude petroleum	20,000	16,847	15	4,646°
Crude paraffin oil	20,000	16,847	15	4,646°
Heavy oil—oil from either slate or coal	20,000	16,847	15	4,646°
Dead oil, or creosote	16,626	14.567	13	4,495°
Coal ... from	13,890	10,001	8·95	2,500°
Coal ... to	14,833	10,817	9·67	2,500°

The use of the vapor of the liquid hydrocarbons used under boilers, and even under the iron stills employed in the distillation of coal-tar of gas-works, as well as of petroleum products, has given most satisfactory results, reducing the time required for distilling a given charge fully one-half, and acting almost without injury to the stills, which are rapidly injured by the use of coal-fires. This difference is probably in great measure due to the much smaller amount of air required to feed the vapor-flame than is used for a coal-fire; 300 cubic feet of air (24 lb.) to the pound of coal being required, while not over half that amount is required to burn the hydrocarbon vapor supplied by a blast of its own production in place of the draft of a high chimney required for air-burning coal. The oxidation of the iron surface is thus largely saved, and the injury from sulphur in coal completely saved by the use of the hydrocarbon vapor. The conclusions reached by the commission referred to are that the evaporative efficacy of liquid fuel for generating steam is much greater than that of coal; and that on board ships there is an important saving of space for storage, as well as in labor of stoking, removing ashes, etc., with a proportional reduction of running expenses; while steam could be raised much quicker by the use of liquid fuel, and save the cost of banking up fires, and the immersion of the vessel more evenly maintained by tanks between the outer and the inner skins of the vessel, to be filled with water as the oil is removed. On the other hand certain obvious dangers attend the storing and use of volatile hydrocarbons, while the odor of the heavy or dead oils would be very annoying, however carefully stored on board ship. These objections do not appear to have been overcome, while for various purposes on land they have little force. Thus in iron-works dead oil has been use with advantage in the furnaces for heating iron plates, etc. It has been found possible to produce a higher, steadier, and more even heat with liquid fuel than with coal, while 8 cwt. are said to have replaced a ton of coal, and the time occupied in heating the iron is said to have amounted to only one-fourth or even one-fifth that required with coal. So that there was a manifest economy in the number of furnaces required to do a given amount of work. Thus, for instance, while the heating of a half-inch plate sufficient for bending would require from fifteen to twenty minutes with coal, it would require only four or five minutes with the liquid fuel; and a 4-inch armor plate requiring three hours to heat with coal required only thirty-eight minutes with the liquid fuel. The "scale" of magnetic oxide of iron formed in the process of heating is much less when liquid fuel is used than with coal, for the reason that there is less free oxygen from the air present, while the vapor of the hydrocarbon affords a reducing flame. In fact, the use of liquid fuel when burnt with a blast affords the same advantages as the gas furnace introduced by Mr. Siemens, which is mentioned further on. The unprecedented increase in the production of petroleum, not only in Pennsylvania, but in other parts of the world also, and which seems far from having reached its limits, renders the use of liquid fuel a subject at the present time of considerable importance. It is largely a question of relative cost, and it is obvious that it must needs be a very low cost indeed which will enable any description of liquid fuel to compete with coal.

Gas.—Natural gas, chiefly marsh-gas, was early observed in the salines of the Kanawha, and has been successfully used as fuel to heat the kettles of certain salt-works. In the city of Erie, Pa., gas obtained from artesian borings has also been used under steam-boilers to produce steam; and the marsh-gas from an artesian well near Rochester has been conveyed into that city for economical purposes. In the oil-regions of Pennsylvania the use of the gas escaping from the artesian wells is frequent for producing steam. The village of Fredonia in New York was as early as 1830 lighted by a natural flow of marsh-gas. Since 1883 natural gas has come into great prominence, both as a heat-producer and as an illuminant. The composition of the gas varies between the limits here stated: 60–80 CH_4, 5–20 H, 1–12 N, 1–8 C_2H_6, 0–2 C_2H_4, 0·3–2 CO_2. For the purpose of generating steam, 1,000 cubic feet of natural gas is equal to 80 to 133 lb. of coal.

Water-gas is of great value as a fuel. It consists of a mixture of carbon-monoxide and hydrogen, which is made by passing steam over highly heated anthracite coal. The heat of a water-gas flame is very high, and this gas is used to advantage for the production of high temperatures.

"The regenerative gas furnace" has worked a revolution in the methods of producing, applying, and economizing heat. The burning of a pound of carbon in pure oxygen to carbonic acid, as before stated, evolves 8,080 calories or units of heat (= 14.544 English units). As each unit of heat is convertible into 774 units of force or mechanical energy, it follows that 1 lb. of carbon represents really $14{,}544 \times 744 = 10{,}820{,}736$ units of potential energy. The mechanical power set free in the combustion of 1 lb. of pure carbon is as much, therefore, as would be required to raise nearly 11,000,000 lb. weight 1 foot high. This would sustain the work called a horse-power for about five and a half hours. This is a result quite unattainable in practice, of course, since, if for no other reason, the two elements of combustion can never be employed in a state of purity, and the oxygen is unavoidably mixed with about four times its own volume of inert nitrogen.

To realize how wide the margin for improvement was in the application of heat for smelting and metallurgical purposes prior to the invention of the regenerative gas furnace, and what this invention has done to economize fuel, it is only necessary to consider a few simple facts. The heat needed to smelt a ton of iron or steel, or to raise the temperature of a like quantity of iron bars to the welding point of malleable iron, is obviously very much more in excess of the amount theoretically required for these purposes than is required in the production of steam, because it is unavoidable that the products of combustion in the ordinary form of heating furnaces should leave the furnace at the temperature of combustion, while only the small excess stored up in the heated iron could be utilized. The remainder escaped unutilized into the chimney, and was lost. Taking the specific heat of iron at ·114 and the welding heat at 2,900° F., it would require $\cdot114 \times 2900 = 331$ units of heat to heat up 1 lb. of iron. Assuming that a pound of common coal develops 12,000 heat-units, one ton of coal should heat up to the welding point 36 tons of iron. But the ordinary reheating furnace heats only about $1\frac{3}{4}$ tons of iron, and therefore produces only about one part in twenty-one of the maximum theoretical effect. In melting steel in pots, in the ordinary Sheffield furnace for that purpose, $2\frac{1}{2}$ tons of coke are consumed to one ton of steel melted. Assuming the melting-point of steel at 3,600° F., and its specific heat at ·119, it takes $\cdot119 \times 3600 = 428$ heat-units to melt a pound of steel; while with 12,000 units at the heat-producing point of common coke, one ton of such coke should theoretically melt 28 tons of steel. In other words, the Sheffield pot furnace utilizes in the melting of steel only $\frac{1}{70}$th part of the theoretical heat of combustion. Here there was obviously a wide margin for securing an important portion of this great loss, and the regenerative gas furnace is the means which in the hands of Messrs. C. W. and Frederick Siemens has solved the problem, in part at least. See Furnace.

In the Siemens furnace the objects to be heated are sustained on a solid support in an atmosphere of burning gas, the oxygen of the atmosphere arriving by one inlet and the combustible gases by another, and the two uniting in a true Hare's blowpipe flame to do their work. The accessory contrivances, so essential in the economy of fuel, for the alternation of the flow of gas and air through the regenerative cellular flues of fire-brick are evidences of a high degree of inventive skill applied to the solution of a problem which, in its essential features, was clearly set forth by Robert Hare in 1802.

It is evident from these facts, which could be greatly extended did space permit, that for many purposes gas is the best form in which fuel can be applied for producing the highest temperature with the least loss of heat, and that the invention of the gas regenerative furnace of Siemens is the most important one yet made in the generation and application of heat.

Wood.—The value of wood as fuel depends mainly on its density in the dry state. Wood is composed of carbon, hydrogen, and oxygen, with a small proportion of nitrogen, and the mineral matter derived from the soil, constituting, when burned, its ash. Fresh or green wood contains from one-fifth to one-half its weight of water, which diminishes its value as fuel more than its proportion by weight, since a certain amount of heat is absorbed in converting this water into steam. Exposed to dry air, wood gradually loses a portion of its water, but being, by its porous nature, peculiarly liable to absorb moisture, it will take up a portion of water from damp air, so that, however well "seasoned" wood may be, it is never free from hygroscopic moisture, and is always in a condition of unstable equilibrium in this respect. Hence furniture and the woodwork in houses in a climate subject to such extremes of temperature and moisture as that of the U. S. is ever liable to change its dimensions between summer and winter. Air-dried wood may be deprived by artificial heat of a further portion of its moisture (kiln-drying). Rumford, who heated various kinds of air-dried wood at the temperature of 240° F. until they ceased to lose weight, obtained the following results:

100 parts of		100 parts of	
Oak wood lost	16·64	Fir wood lost	17·83
Elm " "	18·20	Birch " "	19·38
Beech " "	18·56	Lime " "	18·79
Maple " "	18·63	Poplar "	19·55

Rumford determined the amount of water absorbed by dry wood in the different seasons of the year in France, with the following results:

SPECIES OF WOOD.	100 PARTS IN WEIGHT OF DRY WOOD CUT INTO THIN SHAVINGS AND EXPOSED TO THE AIR, CONTAINED WATER—		
	In summer, at a temp. of 62° F.	In autumn, at a temp. of 52° F.	In winter, at a temp. of 45° F.
	Parts.	Parts.	Parts.
Poplar	6·25	11·35	19·55
Lime	7·78	11·74	17·50
Oak	8·97	12·46	16·64
Elm	8·86	11·12	17·20

From a comparison of these results it appears that woods when exposed to the air at a temperature of 45° F. contain twice the quantity of water they do when the temperature of the air is at 60° F. Rumford found that a sound oak beam which had been in a dry place for over 150 years still contained over 10 per cent. of water, and that a cubic inch of such wood contains more than half a cubic inch of air.

The elementary composition of wood of different sorts presents a very close resemblance. Thirteen different woods offer the following mean result: Carbon, 49·22; hydrogen, 6·25; oxygen, 44·02; nitrogen, 0·90. The differences are within 1 per cent. for the extremes; oak contains about 2 per cent. of nitrogen. The *ash* of wood varies from 8 per cent. in fir to 2½ per cent. in oak. It contains potash, with a little soda as distinguishing constituents (hence *potashes*), much lime and magnesia, with variable but small proportions of iron, manganese, phosphoric acid, chlorine, copper, etc.

PEAT AND TURF.—In many northern countries the vegetation of mosses, ferns, sedges, confervæ, rushes, reeds, and numerous small plants accumulates in swamps, morasses, and low places, each winter adding its quota to the mass of decomposing vegetable matter, in its turn the soil of a new vegetation the ensuing spring. Thus considerable accumulations are formed in process of time, the lower portions of which are black, unctuous, and somewhat dense, and are called *peat*, while the upper layers are spongy, fibrous, and less perfectly decomposed, and are called *turf*. In Holland, North Germany, Ireland, Scotland, and some parts of North America this material is rather extensively used as fuel. Air-dried peat contains from 15 to 20 per cent. of water, and its ash varies from 4 or 5 to 25 per cent., or more, averaging in the denser varieties about 15 per cent. The ash is very poor in potassa and soda, abounds in lime and free sand, while it is remarkable for containing notable quantities of phosphoric acid and sulphuric acid, and sometimes it contains iron pyrites in quantity sufficient to permit its use for the manufacture of green vitriol. (*Karsten.*) No means have yet been devised by which peat can be economically manipulated to compete with coal as fuel.

The calorific power of a fuel is the total amount of heat that can be obtained by its combustion. This is determined by burning a known weight of the particular kind of fuel under investigation, and allowing all the heat generated to act upon a known weight of water. By determining the temperature of the water before and after the combustion the quantity of heat given off can be deduced. The apparatus used for this purpose is called a calorimeter. (See HEAT.) The calorific power can also be determined on the large scale by estimating the amount of water converted into steam in a steam-boiler. Sometimes the calorific power is calculated thus: The fuel consists of carbon, hydrogen, and oxygen. It is assumed that the oxygen is in combination with hydrogen as water, and that the carbon and that part of the hydrogen which is not in combination with oxygen unite completely with oxygen in the process of combustion. As the calorific power of carbon and of hydrogen is known, the calculation can easily be made. Calculations of this kind, as might easily be imagined, give only roughly approximate results. The calorific powers of some fuels have been determined as follows:

	Calories.
Air-dried wood with 20 per cent. H_2O	2,800
Charred wood	3,600
Wood charcoal with 20 per cent. H_2O	6,000
Dry charcoal	7,050
Peat with 20 per cent. H_2O	3,600
Dried peat	4,800
Peat charcoal	5,800
Average bituminous coal	7,500
Good coke	7,050
Coke with 15 per cent. ash	6,000
Air-dried lignite	4,360–5,410
Hydrogen	34,462
Carbon burnt to CO	2,473
Carbon burnt to CO_2	8,080
CO burnt to CO_2	2,403
Marsh-gas	13,063
Olefiant gas	11,858

The value of a fuel is estimated by determining the amount of moisture contained in it, the volatile matter, the fixed carbon, and the sulphur. The chemist can comparatively easily make these determinations, and by the aid of these and of the determination of the calorific power a fairly reliable conclusion can be drawn as to the value of the fuel; but it is also important to note how it burns and other similar points which require the experience of one long accustomed to dealing with such matters.

Formerly fuel was interesting to mankind chiefly as the means of producing artificial heat in cold climates and for its use in the culinary art, which distinguishes civilized man from the savage. But the wonderful advance in modern times in chemical and metallurgical arts, and, above all, the universal introduction of steam as a motor and a vehicle for the transportation of heat, has given to fuel a value before unknown, leading not only to the development of all its available sources of supply, but to the study of its economical application with a view to obtaining from it the greatest useful effect and benefit possible. The phenomena and laws of combustion, and the methods of calculation of calories, are more fully discussed under HEAT; here chiefly the considerations which concern the economic value of fuel.

For a fuller discussion of this subject, consult Percy's *Metallurgy*, vol. i., and the French edition of the same, 1864 (*Traité complet de Métallurgie*); Knapp, *Chemical Technology* by Ronalds and Richardson (vol. i., pp. 8–99); Peclet, *Traité de la Chaleur* (3d ed. 1861, 3 vols.); W. R. Johnson, *Experiments on the Evaporative Power and Other Properties of American Coals* (1843), Cong. Doc., 28th Cong., 1st sess. (Senate, 386); *Dictionary of Applied Chemistry* (Thorpe), vol. ii., art. *Fuel*: Ad. Wurtz, *Dictionnaire de Chimie, Houille*: Marcus Bull, *Experiments to Determine the Comparative Quantities of Heat Evolved in the Combustion of the Principal Varieties of Wood and Coal used in the United States for Fuel*, etc., *Trans. Amer. Phil. Soc.*, (Philadelphia, iii., pp. 1–63, read Apr., 1826); Count Rumford (Benjamin Thompson): Rumford's most important papers on fuel and its use will be found in vols. ii. and iii. of *The Works of Rumford*, published by the American Academy of Arts and Sciences, Boston, 1870–73; in vol. iii. are his well-known papers *Of the Management of Fire and Economy of Fuel*, pp. 1–167, and his Essay X., *On the Construction of Kitchen Fireplaces and Kitchen Utensils*, etc.; De la Beche and Lyon Playfair, *First Report on the Coals suited to the Steam Navy* (Jan. 5, 1848), and *Appendix* by Prof. J. Wilson; *Experiments on the Evaporative Power of the Coals*, by Prof. Wilson and Mr. W. J. Kingsbury; *Experiments for Determining the Coefficient and Evaporative Power of Wood*, etc., by J. Arthur Phillips; *Chemical Analyses of Coals*, by F. C. Wrightson; *Ultimate Analyses of Coals*, by Mr. H. How; and lastly, *Calorific Value of Coals*, by J. A. Phillips, all in *Memoirs of the Geological Survey of Great Britain*, ii., pp. 539–630 (1848); *Report of the Commissioners appointed to Inquire into the several Matters relating to Coal in the United Kingdom*, 1871. *Blue Book C.*, 435, 3 vols. For an important memoir *On the Combustion of Coal*, quoted in the text, see M. A. Scheurer Kestner et Meunier (*Bull. Soc. industr. de Mulhouse*, 1869), cited in *Comptes Rendus de l'Acad. des Sci.*, t. 66, 67, 68, and 69, 1866–69; Kerl's *Metallurgy*, by Crookes and Röhring, in 3 vols.: vol. iii. *Steel—Fuel—Supplement* (New York, 1870). The second chapter of this treatise offers a full and satisfactory discussion, with the important advantage of references to all the more important sources of original information. See Phillips, *Metallurgy* (1874), art. *Fuel*; Bell, *Chemical Phenomena of Iron-smelting* (London, 1872); Box, *Practical Treatise on Heat* (London, 1868); Schinz, *Researches on the Action of the Blast Furnace*, translated by Maw and Müller (London, 1870, etc.); Wagner's *Chemical Technology*, translated by William Crookes (London, 1892); Ost, *Lehrbuch der Technischen Chemie* (Berlin, 1890). See also ANTHRACITE, COAL, CHARCOAL, COKE, CANNEL COAL, LIGNITE; also the articles GAS-LIGHTING, FURNACE, HEAT, FLAME, METALLURGY, NATURAL GAS; while the fuels suitable for various special uses are noted in the different articles on industrial processes and appliances.

Revised by IRA REMSEN.

Fuero, fwā'rō [Span., jurisdiction, judicial code, (formerly) court, seat of justice < Lat. *forum*, market-place, court-town]: the Spanish name for the old local codes of certain towns and districts, chiefly in the north of Spain. The fueros are very ancient, and are regarded with jealous affection by the places that possess them. They are mostly of Basque and Gothic origin.

Fuerteventura, fwer'tā-ven-too'ra': a mountainous and volcanic island, second in size of the Canary islands, and the most thinly populated of the group. It is but little cultivated. Area, 665 sq. miles. Pop. (1887) 10,041. Chief town, Puerto de Cabras.

Fugger, foo'ger: a celebrated German family, now represented by two lines of princes and several lines of counts and "most illustrious counts."—JOHANN FUGGER, a weaver of Graven, near Augsburg, was the founder of the family, which, however, acquired more influence from the success of his eldest son, JOHANN, who became a citizen of Augsburg 1370, and died 1409, leaving a fortune of 3,000 florins.—ANDREW FUGGER, the eldest son of the second Johann, founded the noble line of Fugger vom Reh, which died out in 1583. The descendants of the younger line became leading bankers, miners, and merchants, and the family was ennobled in 1504 by the Emperor Maximilian, who borrowed largely from them. Charles V. was also a borrower from the house of Fugger, whose famous representatives in his day were ANTONY and RAIMUND, who received the county of Kirchberg and Weissenheim, were given the title of counts, and awarded princely privileges. They were stanch Roman Catholics, and used their money freely in opposing the progress of the Reformation. Several were distinguished soldiers and statesmen, and many were liberal patrons of art.

Fughetta, foo-get'tā̆ [Ital., dimin. of *fuga*, by form of *foga*: Fr. *fugue* < Lat. *fuga*, flight. See FUGUE]: in music, a composition in fugue style, but usually shorter, less elaborate, and with more freedom of movement and structure than the regular fugue.

Fugitive-slave Laws: two acts of the U. S. Congress passed (under the provision of Art. IV., Sect. II., Clause 3, of the Constitution) to enable slave-owners to recover fugitive slaves escaping into other States. See SLAVERY.

Fugue, fyug [from Fr. *fugue*: Ital. *fuga*, *foga*, liter., flight < Lat. *fuga*, flight: Gr. φυγή, flight < Indo-Eur. *bhug-*, *bheug-*, *bhoug-*, yield > Sanskr. *bhuj-*, bend: Gr. φυγεῖν, flee]: a form of musical composition in which a certain theme or subject (consisting of a short melodious phrase) is first given out by one of the parts, and then taken up successively by the other parts, elaborately treated in various keys and with various harmonies, with the view of developing its beauty or interest by presenting it in a diversity of aspects and relations. "The designation of *fugue*," says Albrechtsberger, "doubtless originated from one part apparently *flying* before another, while the pursuing part, or answer, imitates the intervals of the first subject, generally precisely on the fifth above or fourth below, or on the octave above or below." Fugues are written for two, three, four, or more voices or parts, each of which in turn takes up the leading theme, and afterward continues its course as tributary to the general harmony. Besides the *simple* (i. e. a fugue with only one theme or subject) there are also *double* fugues, with two or more subjects. Fugues are also distinguished as *strict* or *free*; fugues in double counterpoint of the octave, tenth, or twelfth, etc.; and others in which the *motion* of the theme is changed into the *reverse* or the *retrograde*. A *choral* fugue is one in the course of which a plain choral song or chant is introduced as a new element, standing out in bold and stately form amid the interworking of the other parts, and giving an air of grandeur and sublimity to the whole composition.

The principal or leading theme of a simple fugue is called the "subject." The fugue commences with this, either in the bass or some other part, at the pleasure of the composer. The subject thus given out by the leading part is taken up by one of the other parts and in another key (or grade of the scale), usually by the dominant in answer to the tonic, or by the tonic in answer to the dominant. This is called the "answer." Meanwhile the first part proceeds in notes forming an accompaniment to the answer. A full and accurate knowledge of this form of composition requires much study with a master, and can not be neglected by any would-be composer, because of its intrinsic educational value. Modern music, with its greatly intensified harmonic and emotional effects, makes but comparatively small use of this form, *per se*, but it emphatically does of its spirit. Both the technical and æsthetic sides of this form of composition find their loftiest exposition in the works of Bach and Händel. Treatises on the subject may be found in the works of Cherubini, Albrechtsberger, Richter, Bridges, Prout, etc., but self-instruction is worth but little in conquering this art-form.

DUDLEY BUCK.

Fuh-chow, or **Foo-chow** [locally pronounced **Hok-chiu**, and sometimes spelled FOO-CHOO, FU-CHOW, and FUH-CHAU]: a walled city and treaty-port of China, capital of the province of Fuh-kien, and the residence of the viceroy of the united provinces of Cheh-Min, i. e. of Cheh-kiang and Fuh-kien. It is beautifully situated in a plain bordered by high, well-wooded hills, about 2 miles N. of the northern branch of the river Min, and 34 miles from its mouth; lat. 26° 5' N. and lon. 119° 20' E. (see map of China, ref. 7–K). Its walls have a circuit of 6½ miles, are about 25 feet high, and are pierced by seven gates surmounted by high watch-towers. From the number of mock-banian trees found in the temple-gardens and in the inclosures in which stand the yamuns or official quarters of the numerous provincial officers stationed here, the city has received the name of Yung Ch'ing, or "Banian City." The streets are narrow and dirty, and the shops poor, though well filled with goods. The eastern part of the inclosure contains the Tartar town, where a Manchu garrison has been maintained since the Manchu conquest of Fuh-kien in the latter half of the seventeenth century. On one of the three hills (about 300 feet in height) within the city stands the British consulate, though the consular offices and the residence of the consul are in the foreign settlement, on the northern slope of Nantai, the long narrow island (about 17 miles in length) which here divides the Min in two. The most important suburb is that which stretches from the south gate to the river-bank, where a stone bridge, the Bridge of Ten Thousand Ages, 1,350 feet in length, connects it with Chung-chow (Middle Island), from which another and similarly constructed bridge (less than 300 feet in length) stretches to the island of Nantai. The river here swarms with junks and boats, large numbers of which are used by the natives as dwellings. Sea-going junks anchor below this bridge, while foreign ships discharge their cargoes into lighters 10 miles lower down off an island called Lo Sing by the Chinese and Pagoda Island by foreigners, from a small pagoda on the island. Here on the left bank of the river is the Fuh-chow arsenal (founded in 1867), the most important naval establishment in the empire. It includes a school of navigation and extensive shops and ship-building yards (all under foreign superintendence), from which many war-vessels have been launched. Owing chiefly to its situation, Fuh-chow was never molested by the Taipings. In 1884, however, during the French hostilities in China, a short unequal engagement was fought, in which a Chinese fleet was destroyed and much injury done to the arsenal and the fortifications on the Min. The Chinese loss was estimated at 1,000 killed and 3,000 wounded, while the French loss was only seven killed.

Fuh-chow is one of the five cities opened to foreign trade by the treaty signed at Nanking in 1842. The total foreign imports in 1892 amounted to 4,396,217 haikwan or customhouse taels, and exports to foreign countries to 6,704,372 taels; the gross value of the trade of the port (foreign import and export, as well as native products carried by vessels engaged in the coasting trade) amounted to 12,622,150 haikwan taels. The principal articles of export were tea (5,671,703 taels), wood, including poles, coffins, etc. (251,052 taels), and paper (265,059 taels). In the six years ending 1892 the export of tea had decreased 50 per cent. The principal articles of import are cotton and woolen goods, opium, metals, clocks, kerosene oil, rice, and munitions of war.

Fuh-chow is now connected by telegraph with Canton, Shanghai, Peking, and the principal cities of the empire, as well as by cable with Formosa, Hongkong, and Europe. Pop. (1893) 636,000, including city proper, suburbs, and foreign settlement. R. LILLEY.

Fuh-kien, or **Fokien** (literally, happily established): a maritime province of China, corresponding nearly to the ancient kingdom of Min; bounded on the N. by Cheh-kiang, on the N. W. and W. by Kiangsi, on the S. by Kwangtung, and on the E. by the Formosa Channel. With the exception of some comparatively small tracts along the courses and near the mouths of its two rivers, the Min and the Lung-kiang, its entire area of 38,400 sq. miles is covered with hills, some of them, especially in the N. and N. W., of considerable altitude. Ku-shan, or "Drum Mountain," 6 miles below Fuh-chow, the capital, is 3,000 feet high, and is noted for its great Buddhist monastery, Yuen-fu, perched on its side at a height of 2,000 feet. Tea is extensively grown in this province, the brand known as Bohea taking its name from two ranges of hills known as Wu-yi (in the local dialect *boo-he*). The first tea imported into England in 1666 was grown on the Wu-yi hills in this province. From *te* (pronounced *tay*), the Fuh-kien pronunciation of *cha*, the Chinese word for tea, comes the French *thé*, Italian *tè*, Spanish *té*, German and Dutch *thee*, and the English *tea*. The other products of the province include grains of various kinds, but not sufficient for home consumption, oranges, bamboos, lichis, plantains, and sugar, besides gold, silver, iron, lead, and salt, paper, and cloth. Cotton-mills have been established at Fuh-chow by a native company, which has received special concessions from the government. Fuh-kien has two treaty-ports, FUH-CHOW and AMOY (*qq. v.*). It was among the last of the southern provinces to submit to Manchu rule when the native Ming dynasty was overturned in 1643, and many Fuh-kienese took refuge in Formosa rather than submit. In 1886 FORMOSA (*q. v.*) was detached and made into a separate province, since ceded to Japan. Pop. of Fuh-kien probably about 23,000,000. R. LILLEY.

Fuji-san, foo'jē-saan, or **Fuji-no-yama**: Mt. Fuji, the highest mountain of Japan, frequently but incorrectly called *Fusiyama*. It is a dormant volcano, said to have arisen in one night in the year 285 B. C., while at the same moment the earth near Kioto sank, and Lake Biwa was formed. The last eruption of Fuji took place Nov. 24, 1707, and continued until Jan. 22, 1708. It stands between the provinces of Suruga and Kai, about 60 miles W. of Tokio and the same distance from Yokohama, from both of which places it can be seen towering above the intervening mountains. It is an almost perfect cone, 12,365 feet in height, rising freely from the plain, and presenting the same appearance from whatever side it may be viewed. Hence its name, the *yama* or mountain (in Chinese *san* or *shan*), of one aspect or appearance, *fu-ji* being the Japanese pronunciation of the Chinese *puh-urh*, not two, the word *hing* (in Japanese *kei*), meaning outlines or aspects, being understood. The only deviation from the form of a true cone is a hump called Ho-yei-zan, on the upper slope of the south side of the mountain, and said to have been formed on the occasion of the last eruption. The summit, which is about 2½ miles in circuit, may be reached by four different paths. Fuji is one of the sacred mountains of Japan, and is visited annually by about 20,000 pilgrims. It forms a common but very prominent feature in Japanese decorative art. R. LILLEY.

Fulas: See FELLATAS.

Ful'co, or **Foulques** (Anglicized *Fulk*) **de Neuilly**, fook'-de-nö'yee': one of the greatest pulpit orators of the Middle Ages, and the chief preacher of the fifth crusade; flourished in the second half of the twelfth century. In the first years of his priestly office he led a life of miserable slackness, if not of gross vice, but in seeking to supplement his imperfect ministerial education by attending the lectures of Peter the Chanter, a theologian distinguished for his piety, Fulco's heart was touched, and he tried to atone for his past life by the severest asceticism. In a coarse cowl and girt with leather he journeyed as a preacher of repentance, and fearlessly condemned the vices of learned and unlearned, high and low. His words wrought such compunction that people scourged themselves, threw themselves on the ground, confessed their sins, and declared themselves ready to reform their lives and redress the wrongs they had done. "Many," says Jacob of Vitry, "inflamed with the fire of love and incited by his example, began to teach and to preach, and to lead not a few to repentance." Such a man was eminently qualified to advance the interest of the crusade movement which was just then being preached by Pope Innocent III. Peter the Chanter had been looked to as the great preacher of the fifth crusade, but his sudden death at the very inauguration of the movement led Innocent to select Fulco, and he was asked not only to preach repentance, but to request men to give proof of penitence by hastening to the land of promise. Fulco promptly complied with the papal commission, and of all "orators who blew the sacred trumpet" he was the most successful. He did not, however, live to see the results of the crusade. He died of fever at Neuilly, while the crusaders were still at Venice, in 1202. See Villehardouin, *Histoire de la Conquête de Constantinople* (trans. by T. Smith, London, 1829, 8vo); Milman, *Hist. Latin Christianity*, bk. ix., ch. vii.; Cox, *The Crusades* (New York, 1874).

Fulda, fool'daa: town of Germany; in the electorate of Hesse-Cassel, on railway and on the Fulda; 67 miles by rail N. E. of Frankfort-on-the-Main (see map of German Empire, ref. 5-E). Its cathedral, built in the style of St. Peter's church in Rome, is a beautiful and interesting building. There are excellent schools and considerable manufactures. Fulda was the capital of a former principality of the same name. It was the site of a famous mediæval monastery and abbey, and possessed a university from 1734 to 1803. Pop. (1890) 13,125.

Fulford, fool'furd, Rt. Rev. FRANCIS, D. D.: b. at Sidmouth, England, June 3, 1803; was educated at Exeter College, Oxford, where in 1824 he received a fellowship. He afterward held prominent positions in the Church of England, and in 1850 became Lord-Bishop of Montreal and Metropolitan of Canada. D. at Montreal, Sept. 9, 1868. He was an accomplished scholar, an eloquent preacher, and published *Sermons, The Progress of the Reformation in England* (London, 1841), etc.

Fulgen'tius, FABIUS CLAUDIUS GORDIANUS, Saint: Bishop of Ruspe in Numidia, "the Augustine of the sixth century"; b. at Telepte, in the province of Byzacene, in Africa, 468 A. D.; was intended for civil life, attaining the position of fiscal procurator of the province, but became disgusted with the world and retired to a monastery at Byzacene, and later lived at Sicca Venena. About 500 he visited Rome. On his return to Africa he founded a monastery, and became greatly distinguished for learning and devotion. In 508 he was made Bishop of Ruspe, or Ruspæ, and became one of the ablest apologists of Catholic Christianity. The Arian Vandals predominating, he often provoked their hostility, and was twice banished to Sardinia. In 523 a favorable change in the government brought about a recall of Fulgentius and all other expelled bishops, and thenceforward he enjoyed the possession of his see till A. D. 533, when he died. He was renowned for piety, learning, and every virtue. He is commemorated in the Church of Rome on Jan. 1. His writings are mostly against Arianism and Pelagianism. His most important work is *De veritate prædestinationis et gratia Dei*, directed against the Pelagianism of Faustus of Rhegium. Fulgentius explained "the system of Augustine with consistency, but carefully avoided the harsh points of the Predestinarian view." (Neander, *Ch. Hist.*, ii., 650; Clark's trans., iv., 417 ff; Shedd, *History of Christian Doctrine*, ii., 104 ff; cf. Hagenbach, *Hist. Doctr.*, § 114.) Yet even Fulgentius held in this very work that all unbaptized children, even such as die in the womb, are consigned to damnation—"*æternis et ignibus deputatus.*" Wiggers, *Darstellung des Semipelagianismus* (Hamburg, 1833), ii., 356. Editions of his writings: Basel, 1556, 1566, 1587; Antwerp, 1574; Cologne, 1618; Lyons, 1633, 1652, 1671; best, that of Paris, 1684, 4to, by Saint-Desprez; Venice, 1742, fol., and in Migne, *Patrologia Latina*, tome lviii. See also Schroeckh, *Kirchengeschichte*, xvii., xviii., 108 ff.

Revised by W. S. PERRY.

Fulgentius, FABIUS PLANCIADES: a Latin grammarian of whose life nothing certain is known. He is supposed, from his writings, to have been born or to have lived in Africa about the beginning of the sixth century A. D. Under his name three works have survived, which, though written in a slovenly and diffuse style and full of inaccuracies, still have a value in preserving certain details elsewhere omitted. The first of these works is entitled *Mythologicon* or *Mythologiarum libri III.*, of considerable service in the study of ancient mythology, but full of strange explanations. The second is *Expositio Sermonum Antiquorum*, or, more correctly, *De abstrusis Sermonibus*, a brief list of rare or obsolete expressions, with explanations, most of which have no value. The third is *De Expositione Virgilianæ Continentiæ* (contents, subject-matter), or *De allegoria librorum Virgilii*, an allegorical explanation of Vergil's *Æneid*, as representing human life. Fulgentius appears further, from some expressions, to have been a Christian, and is sometimes confounded with Fulgentius, Bishop of Ruspe, whose theological writings are extant. Another work has come down in part which is ascribed by Teuffel (in his *Hist. Rom. Lit.*) to this Fulgentius, though the name of the author is given as Fabius Claudius Gordianus Fulgentius, and he is generally considered to be neither the grammarian nor the bishop. The title of the work was *Liber absque litteris de ætatibus mundi et hominis*, in as many books as the letters of the alphabet, with the trivial intent, apparently, of enabling him to omit in each book one letter. Of the twenty-three, only fourteen have been preserved; edited by J. Hommey (Paris, 1696). The works of the grammarian Fulgentius are best edited in the *Auctores Mythographi Latini*, by Van Staveren (Leyden, 1742). See *Fulgentius de abstrusis Sermonibus*, by Dr. L. Lersch (Bonn, 1844); Zink, *Der Mytholog. Fulgentius* (Würzburg, 1867); Jungmann, in *Ritschl's Act. Soc. Philol. Lips.*, vol. i. (Leipzig, 1870). Revised by M. Warren.

Ful′gurites [from Lat. *fulguri′tus*, perf. partic. of *fulguri′re*, strike with lightning, deriv. of *fulgur*, lightning, deriv. of *ful′geo*, lighten. See Fulminates]: tubes of vitrified sand found in sandbanks and sandy soils. They are produced by the intense heat of electrical discharges, which fuses the sand together.

Fulham, fo͝ol′am: a western suburb of London, England; situated on the Thames opposite Putney (see map of England, ref. 12–J). It contains the palace of the Bishops of London. Pop. (1901) 137,289.

Fuller, Andrew: theologian; b. at Wicken, Cambridgeshire, England, Feb. 5, 1754; became the Baptist pastor of Soham in 1775, and in 1782 removed to Kettering; bore a prominent part in the propagation of Calvinistic doctrines of a less extreme type than generally prevailed at that time in his denomination, and was one of the leaders in the revival of the foreign mission-work among the English Protestants. Author of *The Gospel Worthy of all Acceptation* (London, 1784); *Dialogues and Letters* (1806); *Calvinistic and Socinian Systems Compared* (1793); *The Gospel its own Witness* (1800); and of many other treatises. His complete *Works* (8 vols., 1824) have been often reprinted. He received the honorary degree of doctor of divinity from the College of New Jersey (1798) and also from Yale College (1805), but he never used it. D. at Kettering, North Hants, May 7, 1815. Fuller's writings are all characterized by intense devotion to "evangelical" Christianity, by vigorous common sense, and by a subtle insight into men and things. He has been styled "the Franklin of theology." See his *Life* by John Ryland (London, 1816); by T. E. Fuller (1863); and by A. G. Fuller (1882).

Fuller, George: figure and portrait painter; b. in Deerfield, Mass., in 1822; studied in Boston, New York, London, and on the Continent; associate National Academy, New York, 1857; member Society of American Artists 1880. He returned to the U. S. in 1860 from his studies abroad and engaged in farming at Deerfield. He did not exhibit his work again until 1876, when he showed fourteen canvases in Boston. In 1879 he exhibited in New York his *Romany Girl* and *And She was a Witch*; in 1880 the *Quadroon* and *Winifred Dysart*; in 1882, *Psyche*; in 1883, *Fedalma*; in 1884, *Arethusa*; and besides the above many portraits. He died in Boston, Mar. 21, 1884. Fuller has been given a high reputation by some writers on art. Soon after his death a memorial exhibition of his works was held in the galleries of the Museum of Fine Arts in Boston. Most of his pictures are owned in Boston; the study for the *Romany Girl* is in the collection of T. B. Clarke, New York.

William A. Coffin.

Fuller, Margaret: See Ossoli.

Fuller, Melville Weston, LL. D.: jurist; b. in Augusta, Me., Feb. 11, 1833; graduated at Bowdoin College 1853; studied law with his uncle, George M. Weston, at Bangor, Me., and attended lectures at law department of Harvard University; commenced practice of law in Augusta, Me., in 1855, but devoted himself chiefly to editorial duties on the *Age*. In 1856 he was president of the common council, and also city solicitor, but resigned both offices and removed to Chicago, Ill., where in 1888 he had practiced law thirty-two years with great honor and success. He was delegate to the State constitutional convention 1861, and to the Democratic national conventions of 1864, 1872, 1876, 1880; member of State Legislature 1863. He is an old-school Democrat, and was nominated by President Cleveland for chief justice of the U. S. Supreme Court Apr. 30, 1888; confirmed July 20, and took the oath of office and his seat Oct. 8.

Fuller, Thomas, D. D.: clergyman and author; b. at Aldwincle, England, June, 1608; graduated B. A. at Queen's College, Cambridge, with the highest honors 1625; M. A. 1628; entered holy orders 1630 as perpetual curate of St. Benet's, Cambridge; became prebendary of Sarum 1631; resigned St. Benet's 1633 and became rector of Broadwindsor, Dorsetshire, 1634; was a member of the convocation 1640; resigned his prebend 1641 and settled in London; later he openly espoused the royal side, and led an unsettled life during the troublous times of the Commonwealth; was made chaplain to Charles II. in 1660 and was created D. D. Author of *David's Hainous Sinne* (a poem, 1631); *History of the Holy War* (1639); *Good Thoughts in Bad Times* (1645; 2d "century" of the same, 1646); *Good Thoughts in Worse Times* (1646); *Mixed Contemplations in Better Times* (1660); *Pisgah-sight of Palestine* (1650); *Holy and Profane State* (1642); *Church History of Britain* (1655); *Worthies of England* (1662); and a few less important works. His writings are remarkable for quaintness of style, for wit, sagacity, learning, and moral elevation; and the *Good Thoughts*, *Worthies*, *Church History*, and *Holy and Profane State* are English classics. D. in London, Aug. 15, 1661. The best biography is by J. E. Bailey (London, 1874).

Revised by S. M. Jackson.

Fuller's Earth: a greenish-white oölitic clay, chiefly found in Bedfordshire, Kent, and Surrey in England, and at many points on the Continent. From one-fourth to one-fifth of the mass is alumina, the rest chiefly silica and water, with some lime and other ingredients. It was formerly much used by cloth-dressers for cleansing the oil from woolen fabrics. Though in part superseded by soap, it is still used to a considerable extent by European manufacturers because it is much cheaper than soap, and if of good quality is scarcely less effective. Cimolian earth and various argillaceous substances share this detergent property. The annual consumption of fuller's earth in Great Britain is said to have amounted at one time to 6,000 tons.

Fullerton, Lady Georgiana Charlotte (*Gower*): English author; daughter of Lord Granville Leveson Gower; b. at Tixall Hall, Staffordshire, Sept. 23, 1812. She was married to an Irish gentleman, Alexander George Fullerton, in 1833, and in 1846 followed her husband into the Roman Catholic Church. She was distinguished for her works of benevolence and philanthropy, and her books, some thirty in number, and including several novels, are of a strongly religious and Catholic temper. Among them are *Constance Sherwood* (1865); *Mrs. Gerald's Niece* (1869); *The Gold Digger and other Verses* (1871); besides numerous lives of saints, memoirs of Catholic worthies, and translations from the French and the Italian. See *The Life of Lady Georgiana Fullerton*, translated from the French of Madame Augustus Craven by Rev. Henry James Coleridge (London, 1888). D. Jan. 19, 1885. H. A. Beers.

Fulling [deriv. of *full*, whiten < M. Eng. *fullen*, from O. Fr. *fouler* (but prob. under influence of *fuller* < O. Eng. *fullere*, from Lat. *fullo*, fuller) < Low Lat. *fullare*, full, deriv. of *fullo*, fuller]: an operation by which fabrics made of carded wool are shrunk, thickened, and partially felted. The woven goods are scoured and boiled (to remove knots and lumps), then soaped very thoroughly, and finally either beaten in the fulling-stocks or passed through great rollers. This operation is much like the previous scouring, except that fuller's earth, hog's dung, and urine are used in the scouring, while soap and hot steam are used in the fulling proper. The fulling process lasts from forty-eight to sixty-five hours. When complete, the threads of the cloth are scarcely perceptible, the tendency to unravel is overcome, and the cloth shrinks often nearly one-fourth in length and sometimes about one-half in breadth. The shrinkage is much less when dyed wool has been used.

Fulmar, fŭl'määr: any one of several sea-birds of the genus *Fulmarus*, web-footed birds that feed upon fish, dead whales, cirripeds, mollusks, etc. The best known is the *Fulmarus glacialis*, fulmar or fulmar petrel of the North Atlantic. This bird is much sought for by the fowlers upon the cliffs of St. Kilda, who gather its eggs (which are highly prized), its feathers and down, and the fish-oil in its stomach, which is commercially valuable. Another species is the *Fulmarus giganteus* of the Pacific, a bird as large as a goose. See Petrel.

Fulminates [deriv. of *fulmin-*, compounding form of *fulminic acid*, i. e. explosive acid, *fulminic* being deriv. of Lat. *fulmen*, **fulgmen*, lightning, deriv. of *fulgeo*, lighten. See Fulgurites]: salts of fulminic acid, which is not known in the free state. It forms salts with a great number of bases, but only a few of them are of importance.

Fulminating mercury is highly explosive, and its action is so sudden that it may be said to detonate. It explodes when heated to 186° C. or if exposed to a strong blow, and its force is somewhat greater than that of gunpowder; but, while it is more violent, its sphere of action is very limited. It is therefore of no practical value as an explosive agent in blasting or gunnery, but the readiness with which it may be fired makes it of great importance as a means of causing the explosion of other substances. In percussion-caps, primers, and friction-primers fulminating mercury is rarely used pure, but is mixed with saltpeter, mealed powder, or other bodies. See Explosives.

Fulton: city and railway center; Whiteside co., Ill. (for location of county, see map of Illinois, ref. 2–D); on the Mississippi river, and on the Chicago and Northwestern Railway; 135 miles W. of Chicago. It is the southern terminus of a line of steamers which, during the season, bring down millions of bushels of grain from Wisconsin, Minnesota, and Northwestern Illinois, and on their return trip take up great quantities of merchandise, agricultural implements, etc. Fulton has a large elevator, pipe-factories, a stoneware-factory, and carriage-factories, and its lumber interests are very important. The Northern Illinois College is situated here. Pop. (1880) 1,733; (1890) 2,099; (1900) 2,685.

Fulton: town; Fulton co., Ky. (for location of county, see map of Kentucky, ref. 5–B); junction of the Illinois Central and the Newport News and Mississippi Valley Railroads; in a fine agricultural region. It has two colleges, a foundry, spoke-factories, planing-mills, and manufactures of wagons, tobacco, flour, lumber, etc. Cotton-ginning and wool-carding are also carried on. Pop. (1880) 826; (1890) 1,818; (1900) 2,860. Editor of "Fultonian."

Fulton: city; capital of Callaway co., Mo. (for location of county, see map of Missouri, ref. 4–H); on the Chicago and Alton Railroad; 25 miles N. E. of Jefferson City and 25 miles S. of Mexico. It has 6 churches, fine public schools, and many other educational and benevolent institutions, among them a Presbyterian college, 2 schools for females, a State orphan school for girls (Christian), and the State asylums for deaf-mutes and for the insane. Coal and fire-clay are in abundance, and the city has a fine pottery and an excellent system of water-works supplied from sources 900 feet below the surface. Principal business, farming and stock-raising. Pop. (1880) 2,409; (1890) 4,314; (1900) 4,883. Editor of "Gazette."

Fulton: village; Oswego co., N. Y. (for location of county, see map of New York, ref. 3–G); on Oswego river and Oswego Canal and the N. Y. Cent. and Hudson R. Railroad; 24 miles N. of Syracuse and 12 miles S. of Oswego. It has 8 churches, an academy, ample water-power, 5 flour-mills, 2 buckwheat-mills, 2 edge-tool works, 3 paper-mills, 3 pulp-mills, a large manufactory of firearms, a woolen-mill, and manufactures of paper-mill machinery, pulleys, cider-mills, etc. It is an important cheese-market. Pop. (1880) 3,941; (1890) 4,214; (1900) 5,281.

Editor of "Patriot and Gazette."

Fulton, Robert: inventor; b. at Little Britain, Lancaster co., Pa., in 1765, of Scotch-Irish stock; went to Philadelphia when seventeen years old, and practiced the art of miniature-painting there and in New York with such pecuniary success that he was soon able to purchase a farm for his mother's support, whereupon he went to London and became a pupil of West; and throughout life he retained his early fondness for art, in which he from time to time made attempts which indicate very considerable power and capacity as an artist. In Great Britain he met with the Duke of Bridgewater, the father of the British canal system; with Lord Stanhope, an enthusiastic mechanician; and with Watt, the inventor of the steam-engine; and by their direct or indirect influence his attention was turned strongly to mechanical invention, his true field of labor. His machines for marble-sawing, rope-making, flax-spinning, and removing earth from excavations soon after appeared. His *Treatise on the Improvement of Canal Navigation* (1796) and a series of essays on canals were followed by a British patent for canal improvements, consisting chiefly in the substitution of inclined planes for locks. He resided in Paris 1797–1806, and there brought forward a submarine torpedo-boat for maritime defense, which was successively rejected by the French, the British (1805), and the U. S. Governments (1810). In 1803 he undertook the construction of a steamboat on the Seine, having in 1793 addressed a letter upon the subject to Lord Stanhope, himself an experimenter in steam-navigation. Fulton (in 1803), in company with Henry Bell, the first successful British steam-navigator, visited the Clyde, where Symington's Charlotte Douglas, a steam canal tow-boat, was then plying. But Fulton's Seine experiment was but partly successful. Aided, however, by Chancellor Livingston, then U. S. minister in France, he purchased (1806) a Boulton and Watt engine and shipped it to New York, where, after careful study of the defects and merits of previous attempts in the same direction, he built and launched (in 1807) the Clermont, his first successful steamboat, which, however, attained a speed of only 5 miles an hour when going up the North river. His first U. S. patents (1809 and 1811) covered only some points regarding the attachment of the paddle-wheels to the axle of the crank, and throughout life Fulton was involved in lawsuits with parties infringing upon his claims. He constructed many steamboats, ferryboats, etc., among the most remarkable of which was the U. S. steamer "Demologos," afterward called *Fulton the First* (built 1814–15), the first war-steamer ever constructed. She never attained much speed, and in 1829 was blown up by accident. Fulton died in New York, Feb. 24, 1815. See Colden's *Life of Fulton* (1817); Preble's *History of Steam Navigation* (1883); and Knox's *Fulton and Steam Navigation* (1886).

Fultonville: village; Montgomery co., N. Y. (for location of county, see map of New York, ref. 4–I); on the Erie Canal and Mohawk river, and on the West Shore Railroad: 44 miles W. of Albany; in a rich farming district; connected with Fonda, the county-seat, and the Central Railway dépôt by an iron bridge costing $50,000. It has three churches, a union free school, a public library, a silk-mill, broom-factory, foundry, steam lumber-mill, steam flour-mill, and grain elevator. Pop. (1880) 881; (1890) 1,122; (1900) 977.

Editor of "Montgomery County Republican."

Ful'via: a Roman lady; daughter of M. Fulvius Bambalio; was the wife of P. Clodius, by whom she had a daughter, Clodia, afterward wife of Augustus. After the murder of Clodius, she married C. Scribonius Curio, and her third husband was Mark Antony, whom she loved sincerely, and for whose sake she abandoned the dissolute habits of her earlier life, entering heartily into his ambitious plans, and behaving with great cruelty to his enemies. When her husband was dallying with Cleopatra she created an insurrection for the purpose of recalling him, but was driven from Italy. At Athens she met her husband, who treated her with great harshness, whereupon she retired to Sicyon, and soon after died of chagrin (b. c. 40). The triumvirs were then reconciled, and Antony married Octavia, sister of Augustus. Fulvia left two sons by Antony.

Fumigation [deriv. of *fumigate*, from Lat. *fumiga're*, *fumiga'tum*, fumigate; *fu'mus*, smoke + *a'gere* + drive]: the application of smoke, gases, or vapors for various purposes, as to produce or destroy odors: to bleach in certain manufacturing processes—to destroy infection; to act as a local application in diseases of the air-passages, and to form a part of the ritual in certain religious ceremonies. For the use of fumigation by sulphurous acid or chlorine, see Disinfection. The fumes of burning sulphur are employed for bleaching straw. For medicinal purposes the fumes of stramonium, tobacco, nascent muriate of ammonia, oxide of mercury, and of various gum resins are sometimes employed. J. S. Billings.

Fu'mitory [altered by analogy with words ending in *-ory* from M. Eng. *fumetere*, from O. Fr. *fume-terre*, from Low

Lat. *fumus-terræ*; *fumus*, smoke + *terræ*, of the ground, gen. of *terra*, ground]: the *Fumaria officinalis*; a weed of Europe, now naturalized in the U. S.; belonging to the family *Fumariaceæ*. It is a rather handsome herb, with a strong, disagreeable taste. Its sap abounds in saline matter and a principle called fumarin. Fumaric acid is also reported to be found. This herb is in parts of Europe valued as a tonic, diaphoretic, and aperient, and is esteemed for the treatment of skin diseases. The climbing fumitory of the U. S., called also mountain-fringe, is a delicate biennial, the *Adlumia cirrosa* of the same family, which is very fine in cultivation when trained in a shady place upon latticework. Revised by CHARLES E. BESSEY.

Funchal, foon-shaal′ [Portug., liter. (place) of fennel, deriv. of *funcho*, fennel < Lat. *feni′culum*, whence Eng. *fennel*]: the capital of the island of Madeira; situated on its southern coast; lat. 32° 37′ N., lon. 16° 54·5′ W. It is a handsome place, with a good harbor, and the center of the wine-trade of the island, and is a bishop's see. The climate is salubrious, and the place has a hospital for consumptives. Pop. 20,000.

Funck, foonk, or **Func′cius**, JOHN NICHOLAS: Latin scholar; b. at Marburg, Mar. 29, 1693; appointed in 1730 Professor of Eloquence and librarian in the academy at Rinteln, at which place he died Dec. 17, 1777. His chief contribution to classical learning is a history of the Latin language, which he divides into periods corresponding to the different periods of man's life, to each of which a separate treatise is devoted. The titles and dates of publication are *De Origine Latinæ linguæ tractatus* (Giessen, 1720; 2d ed. Marburg, 1735); *De Pueritia Latinæ linguæ* (Marburg, 1720); *De Adolescentia ling. Latinæ* (*ib.*, 1723); *De Virili Ætate ling. Latinæ*, in 2 parts (*ib.*, 1727–30); *De imminenti linguæ Latinæ Senectute* (*ib.*, 1736); *De Vegeta ling. Lat. Senectute* (*ib.*, 1744); *De inertia et decrepita ling. Lat. Senectute* (Lemgo, 1750). Besides these, Funck published the fragments of the *Laws of the XII. Tables* (Rinteln, 1744), and several minor works. H. DRISLER.

Funcke, OTTO: See the Appendix.

Function [from O. Fr. *function* > Fr. *fonction* < Lat. *func′tio*, performance, execution, deriv. of *fun′gi*, *func′tus sum*, perform]: in mathematics, a quantity which is conceived to depend upon, or be produced by, some other quantity to which values can be assigned at pleasure. The latter quantity is called an *independent variable*. We then conceive that for every value we choose to assign to the independent variable a certain value of the function will result. A simple illustration is afforded by the relation between the time required for a train to pass over a certain distance and the velocity of the train. The distance from New York to Washington being 225 miles, a train running at a mean speed of 45 miles per hour will make the distance in five hours; at a speed of $37\frac{1}{2}$ miles an hour, it will make it in six hours. If we assign any value we please to the speed, we can compute a corresponding value of the time by simple division. The mathematician would then say that the *time* is a function of the *speed*. Conversely, we may say that the speed is a function of the time; that is, assign any time we please as that within which the train is required to run, and we can compute a corresponding speed at which the train must run.

In mathematics a function is commonly expressed as equal to a certain algebraic expression containing an independent variable. It is then called an explicit function. It follows from this that there may be as many kinds of explicit functions as we can form algebraic expressions, and they are therefore classified according to the nature of the expression which represents them. Entire functions are so called because they are of the nature of an integer, or entire number. They are those the formation of which involves no operation except addition, subtraction, and multiplication. Thus $ax + by$ is an entire function of the quantities which enter into it. So also is $a + bx + cx^2 + dx^3 +$ etc. This expression is called an entire function of x, because it may be formed by multiplying x by itself, thus forming its powers; then multiplying these powers by the factors a, b, c, d, etc., and then adding them, thus requiring no operations except those we have named.

A rational function is one which involves only the operations of addition, subtraction, multiplication, and division upon the quantities which enter into it. Such a function is

$$\frac{ax + by}{mx + ny}.$$

An irrational function is one which requires the extraction of a root and which can not be represented by a rational quantity. Thus the cube root of a^3 is not irrational, because it is equal to a simply; but the cube root of a^2 is irrational.

The three classes of functions just defined are sometimes called algebraic, and all others transcendental.

An implicit function is one which is expressed as the unknown quantity or root of an equation. Such a root depends for its value upon the coefficients of the unknown quantity, and is therefore considered as a function of those coefficients. If the equation by which the roots are defined does not exceed the fourth degree, the root may be represented as an irrational function of the coefficients (see EQUATION); but if the equation is general in its form, and is of the fifth or any higher degree, no such representation is possible. S. NEWCOMB.

Function (mental): See PSYCHOLOGY.

Fundamental Bass: in music, the lowest term of a chord when that chord is in its original or natural form—the root or tonic as contradistinguished from the bass of *inverted* chords.

Fundamental Chord: (1) a chord in its original or normal form, not inverted; (2) a chord not accidental, anomalous, derived, etc., but essential and indispensable; as, e. g., the major and minor triads and the chord of the seventh.

Fundamentals, or **Fundamental Articles of Faith** [*fundamental* is from Low Lat. *fundamenta′lis*, pertaining to a foundation, concerning the foundation; deriv. of *fundamen′tum*, foundation; deriv. of *funda′re*, found; deriv. of *fundus*, bottom]: those doctrines which lie at the basis of a system or are involved in the right of a system to exist—its foundation. It is a relative term, and when a doctrine is asserted to be fundamental a necessary question always is, To *what?* It is also expressive of degrees of necessity, and allows of the question In what respect? It is therefore never a defining word till it has been defined. There may be a perfect agreement on the general sense of the word, and a total diversity as to the propriety of its application. Fundamentals are more or less generic as that to which they are related has more or less of the generic in it. If a doctrine be conceded to be fundamental to Christianity, it must be held by every one entitled to the name of Christian. But each Christian body has doctrines fundamental to its system which are not held by the entire Christian Church. Fundamentals have been divided into—(1) primary, or those doctrines the explicit knowledge of which is necessary to salvation; and (2) secondary, or those doctrines which are implied in the primary, and the denial of which logically involves the denial of the primary fundamentals. They have also been divided into (1) constituent and (2) conservative, or those doctrines which enter into a system as constituent parts in the sense that the system can not be stated without explicitly stating them, and those doctrines which are only logically involved in a system, in the sense that the denial of them logically involves the denial of the system in some of its constituent parts. They have still further been divided into (1) formative and (2) distinctive, or those doctrines which so lie at the basis of the system as that the system is but the unfolding of their contents, and those which differentiate and discriminate a system from some other system or from all other systems. These distinctions obviously cover largely the same ground. Involuntary ignorance of the secondary fundamentals does not remove the foundation of salvation, but denial of them does. And in like manner ignorance or neglect of the conservative or distinctive fundamentals does not invalidate a system, but denial of them does. The doctrine of fundamentals has been most agitated in the efforts to unite the Lutherans and the Reformed; but it necessarily forms a part of all controversy between parties in all communions. Revised by B. B. WARFIELD.

Funds and **Funding** [*fund* is from O. Fr. *fond*, bottom, foundation, capital > Fr. *fond* < Lat. *fundus*, for **fudnus* < Indo-Eur. *bhudhnos* > Sanskr. *budhna*: Gr. πυθμήν: Ir. *bonn*, sole of foot: Teuton. *budma* > Germ. *Boden*, floor: Eng. *bottom*]: money or other form of wealth accumulated and devoted to, or available for, some special purpose or enterprise. In Great Britain the securities issued for the national debt are known as the *public funds*, or simply as the *funds*. The process of funding a debt consists in dividing it into parts or shares (bonds) with stated times of payment of interest and principal, the latter usually at a remote date. The substitution of bonds of lower rate for those of higher rate


BOLETUS EDULIS.
THE MOREL.
MORCHELLA ESCULATA.
THE CORAL FUNGUS.
CLAVARIA FORMOSA.
SHAGGY-MANE MUSHROOM.
COPRINUS COMATUS.
PUFF BALLS.
LICOPERDON GIGANTEUM. L. GEMMATUM.
L. SACCATUM.
THE OYSTER MUSHROOM.
AGARICUS OSTREATUS.
THE MUSHROOM.
AGARICUS CAMPESTRIS.
FLY MUSHROOM.
AGARICUS (AMANITA) MUSCARIAS. POISONOUS.
AGARICUS (LEPIOTA) PROCERUS.
BEEFSTEAK MUSHROOM.
FISTULINA HEPATICA.
MARASMIUS URENS. M. PERONATUS.
POISONOUS.
AGARICUS (AMANITA) PANTHERINUS.
RUSSULA EMETICA.
POISONOUS.

FUNGI.

is often called *refunding*; provision, made by agreement, from year to year for the payment of the principal is known as a sinking fund. Funded debt is opposed to *floating* debt, which consists of notes and overdue bills; and to current debt, which consists of bills and other adverse balances already incurred but not yet overdue. See FINANCE and DEBT, PUBLIC. A. T. HADLEY.

Fundy, Bay of [earlier **Fundy Bay**, from Fr. *fond de la baie*, head of the bay]; an arm of the Atlantic extending N. E. between New Brunswick on the N. W. and Nova Scotia on the S. E. Its northeast extremity divides into two parts—Chignecto Channel, the northwesternmost, itself dividing into Shepody Bay and the Cumberland Basin, the latter reaching to within 13 miles of Northumberland Strait; the northeast arm of the bay is composed of Minas Channel and Basin and Cobequid Bay. Spring tides, in parts of the Bay of Fundy, have been known to rise over 70 feet, and come pouring in like an immense *bore*. The funnel-shaped and rapidly narrowing entrance to the bay enables a disproportionately long tidal wave to enter, and as it becomes narrower and shallower the height is necessarily increased. The remarkable tidal peculiarities render navigation dangerous except to those who are familiar with it. The fisheries are of great importance. See *Baie Verte Canal*, in the article SHIP-RAILWAYS.

Fü'nen, or **Fuhnen** (Dan. *Eyen*): next to Seeland, the largest of the Danish islands; separated from Seeland by the Great Belt and from Jutland by the Little Belt. Area, 1,123 sq. miles. It is low, but hilly, partly covered with forests, and very fertile. The principal towns are Odense, Svendborg, and Nyborg. Pop. 206,528.

Fu'neral, Funeral Rites [Lat. *funus, funeris*, a dead body]: The disposal of the bodies of the departed has in all ages and in nearly all countries excited a profound interest in the living. The two principal modes which are and have been observed are *burial* in the earth or sea, and *cremation*, incineration or burning. (See CREMATION.) Burial has been practiced from remote prehistoric times, as is shown not only by the most ancient existing records, but by the examination of cairns and sepulchral mounds in many countries. Burials are either in graves, in which the body (usually either inclosed in a coffin or cist, or among ruder peoples simply wrapped in grave-clothes) is covered directly with the earth, or it is placed in a subterraneous chamber called a vault, tomb, or sepulcher. The *embalming* of dead bodies (see EMBALMING and MUMMY) is a process anciently very prevalent in Egypt and some other countries preparatory to burial. Burial in the sea takes place from ships which are too far from the land to permit interment to take place. The body, placed in a suitable canvas sack, is (very commonly after the reading of the short and impressive burial-service of the Anglican Church) committed to the sea, shot or other suitable weights being attached to the feet. Burial in the earth is usually accompanied by ceremonies prompted at once by affection and by the religious faith and sentiments of the friends of the deceased. Masses and requiems are prescribed in the rituals of some Christian churches; eulogies, elaborate *oraisons funèbres*, or formal sermons are pronounced at or soon after the funerals of distinguished persons; but more commonly in Protestant communities a simple liturgical service, or a still less formal scriptural reading, followed by a few words of sympathy and religious counsel, with a prayer for the living friends, completes the service. Music is not universal at funerals; when used it is either in a minor key and expressive of grief, or of a kind intended to inspire hope and religious faith. A simple bier, or, in the case of public characters of distinction, a more or less imposing catafalque or hearse, is employed for the support of the coffin; and funeral cars (also called hearses) are almost uniformly employed in carrying the dead to the grave. The custom of having hired mourners to bewail the dead is at present prevalent chiefly in the East. The *hearse*, in strict language, is the candle-frame used in Roman Catholic services for the support of burning tapers. The dead are almost always buried in the supine position, very commonly with the head toward the E.—a custom which may have a religious significance, but which prevailed to some extent among the aborigines of North America. Some of these peoples, however, like the Kaffirs, buried the dead in a sitting posture—a custom which was once common in the south of Britain, as is shown by the examination of sepulchral mounds referred somewhat doubtfully to a prehistoric age. Graves have been discovered in North Carolina in which the dead were placed very near the surface of the ground, and covered with soft clay, which was afterward hardened by fire. Many Western aboriginal tribes suspended their dead in trees or placed them upon raised platforms—a practice which may have been designed to keep them from ravenous beasts. Some Indian tribes carry the bones of the dead with them on their migrations; others have the greatest horror of ever speaking of the dead; while among some tribes there prevails a system of ancestral worship which recalls that so prevalent in China, and a solemn dance is held yearly at the burial-place. The Parsees expose their dead until the kites and vultures have removed the soft tissues, when the bones are placed in an ossuary. A very similar practice obtains among some wild South American tribes. In many European monasteries there are ossuaries for the bones of the deceased brothers. Burial is believed to have prevailed quite as extensively in ancient Greece as burning did; and it was undoubtedly far more prevalent in Rome than burning until a comparatively late period of the republic.

Funes, GREGORIO: Argentine historian; b. at Cordoba, 1749. He graduated in theology and canon law at the University of Cordoba; was rector of a college at Loreto; and later rector of his own university and dean of the Cathedral of Cordoba. During the events which led to the independence of the Platine states he was active in politics. Dean Funes was an eminent pulpit orator and theologian. His most important historical work is *Ensayo de la historia civil del Paraguay, Buenos Ayres y Tucuman* (3 vols. 8vo, 1816). D. in Buenos Ayres, 1830. H. H. S.

Fünfkirchen, fünf'kirch-en [Germ., liter., Five-churches, Slavic *Pecs*, liter., Five]: town of Hungary; capital of the county of Baranya; 139 miles S. by W. of Budapest (see map of Austria-Hungary, ref. 7–G). Its cathedral is the largest and handsomest church building in Hungary. It has a college and other important educational institutions, and is a bishop's see, established in 1009. Its trade is very active, and it has coal mines, marble quarries, tanneries, and manufactures of woolens, flannels, brandy, and majolica-ware. There are interesting remains of the Roman and Turkish periods, for the Turks held this town 1543–1686. Pop. (1891) 33,780.

Fungi [plural of Lat. *fungus*, a mushroom]: those lower plants which are parasitic or saprophytic, and which as a consequence are destitute of chlorophyll; in systematic botany, such plants as an order or class, a usage which is obsolescent. In a natural system of classification the fungi are distributed among a number of classes of lower plants, with which their affinities have been pretty clearly made out. (See VEGETABLE KINGDOM.) Although the name Fungi must be abandoned as the designation of a natural group of plants, it may well be used as a general term for all the chlorophyll-less plants below the Mossworts, and in this sense it will be used throughout this article. In recent years, for no very good reason, the bacteria have been pretty generally excluded from the fungi, and it is now pretty evident that the Slime Moulds (*Myxogastres* or *Myxomycetes*) are more at home in the animal kingdom. The latter accordingly deserve no further notice in this article, and as the former have been fully discussed under BACTERIA, they will require only brief mention here. For fossil fungi, see PLANTS, FOSSIL, and for those fungi that are active agents in the process of fermentation, see FERMENTATION.

Systematic.—The lowest fungi are the Bacteria (*Bacteriaceæ*), which are to be regarded as degraded Water Slimes (*Schizophyceæ*). See BACTERIA.

The Green Slimes (order *Protococcaceæ*) have given rise to one or two small families of one-celled or few-celled parasites, the *Synchytriaceæ* and *Chytridiaceæ*, which infest aquatic plants and animals (Fig. 1).

The Pond Scums (order *Conjugatæ*) appear to have given us two families of fungi, the Black Moulds (*Mucoraceæ*), which are mostly saprophytic, and the Insect Fungi (*Entomophthoraceæ*), all parasites, and well represented by the common FLY FUNGUS (*q. v.*). See also MUCORACEÆ.

From the Green Felts (order *Siphoneæ*) have come, by degradation through parasitism, the Water Moulds (*Saprolegniaceæ*) and the Downy Mildews and White Rusts (*Peronosporaceæ*). See MOULDS, MILDEWS, and RUSTS.

By far the greater number of fungi have apparently sprung from the simpler Red Seaweeds, or more probably from Coleochæte-like plants. From this beginning two great diverging and branching classes have sprung, viz., the Sac-Fungi (*Ascomycetes*) and the Higher Fungi (*Basidio-*

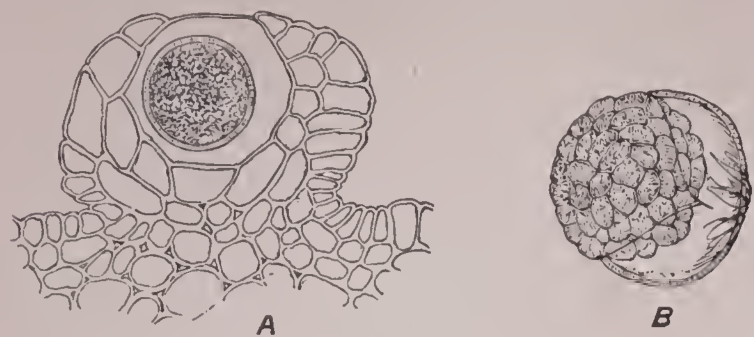


FIG. 1.—A, resting state of *Synchytrium mercurialis*, in a wart upon the leaf of Mercurialis ; B, the same germinating.

mycetes), differing mainly in the fact that in the first certain end-cells form spores by internal cell-division (endosporous, Fig. 2, A), while in the second they are formed by the enlargement of external protrusions (exosporous, Fig. 2, B).

A cell of the type A in the figure is a sac or *ascus* (pl. *asci*), and its spores are sac-spores or ascospores. A cell of the type B is a *basidium* (pl. *basidia*), and its spores are basidiospores.

Under the Sac-Fungi, which include more than 16,000 known species, may be distinguished six or seven pretty plainly marked orders as follows :

The Simple Sac-Fungi (*Perisporiaceæ*) consist of slender branching threads (cell-rows), which form a vegetative mould-like mass (the *mycelium*) of greater or less extent. From this certain branches grow up vertically, and by simple abstriction of the end-cells form asexual spores (summer-spores or conidia), whose function is rapid propagation while conditions are favorable (Fig. 3). Somewhat later the little dark-colored sexually formed fruits (*perithecia*) are formed. These are mostly globular structures containing a number of spore-sacs. It is now thought that in many cases the sexual organs are abortive through degeneration, and that the fruits develop without an actual fertilization. Many of the species (especially in the Powdery Mildews—*Erysipheæ*) are surface parasites upon the leaves and stems of the higher plants. See MILDEW.

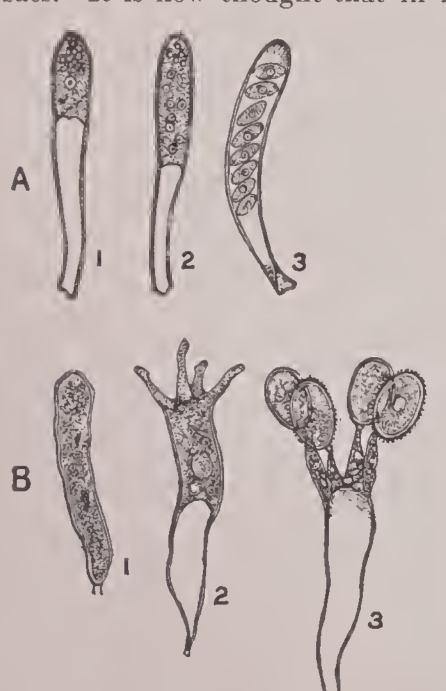


FIG. 2.—A, cells with spores formed internally ; B, spores formed externally.

The Subterranean Sac-Fungi (*Tuberoideæ*) resemble the foregoing, but have compound fleshy fruits. They are saprophytic, living upon decaying organic matter in the soil. The Truffles (family *Tuberaceæ*) are familiar examples of this order.

The BLACK FUNGI (*q.v.*) (*Pyrenomyceteæ*) include a great number of mostly parasitic or semi-parasitic species, referable to six or seven families, and pretty largely characterized by a sooty or blackish color. The simpler forms (Fig. 4, A, B, C) are scarcely to be separated from the Perisporiaceæ, but in the greater number of species the compound fruits are characteristic (Fig. 4, D, E, F). Many of the most injurious fungi are to be found in this order, which contains about 10,000 known species. See ERGOT and PLUM KNOT.

The Lichens (*Lichenes*) include a number of families of fungi, which are peculiar in being parasitic upon very small green plants (algæ) of the lower families, e. g. *Chroococcaceæ*, *Nostocaceæ*, *Palmellaceæ*, *Chroolepediaceæ*. These fungi are very closely related to the Black fungi and Cup fungi, from which they are scarcely to be separated. See LICHENS.

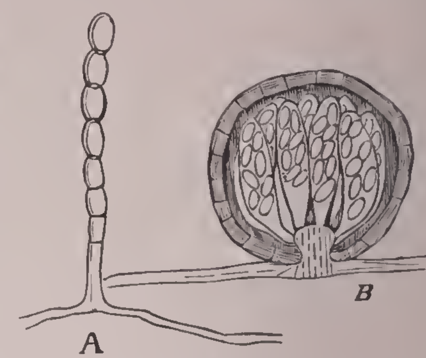


FIG. 3.—A, formation of conidia of Rose Mildew (*Sphærotheca pannosa* ; B, ideal section of a fruit of a Powdery Mildew.

The Cup fungi (*Discomyceteæ*) are pretty generally fleshy and more or less disk-like or cup-shaped in the fruiting stage. They are mostly saprophytic, although a good many species are parasites. In the saprophytic species the slender white threads of the plant creep through the decaying organic matter, and finally form sexual organs, a flask-shaped carpogone (the female organ) and a club-shaped antherid, the male organ (Fig. 5, A). After fertilization many threads grow upward and form a disk or cup shaped structure, in the substance of which spore-sacs develop (Fig. 5, B, C). In the common Morel (*Morchella esculenta*, Fig. 6) the spore-bearing tissue is everted, pitted, and folded, so as to give it the appearance of a compound cup-fungus raised upon a common stalk.

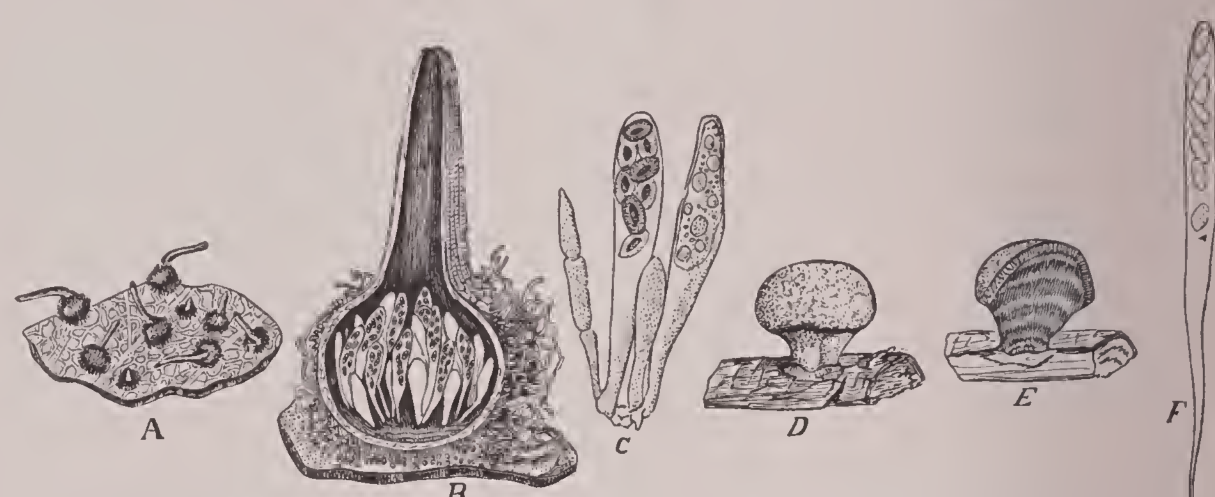


FIG. 4.—A, fruits of *Melanospora chionea* on a leaf-fragment ; B, a fruit cut vertically ; C, spore-sacs ; D, *Daldinia concentrica* on a twig ; E, section of same ; F, spore-sac.

In addition to many interesting genera—*Peziza*, *Ascobolus*, *Helvella*, *Phacidium*—there are a number of excessively reduced forms, as the parasitic Leaf Curl and Plum Pockets (Exoascus, Fig. 7, A), and other similar fungi of the genera *Taphrina*, *Eremascus*, *Gymnoascus*, etc. The plants are here reduced to little more than spore-sacs, the vegetative organs having nearly disappeared. This degradation is carried a step further in the yeast-fungi (*Saccha-*

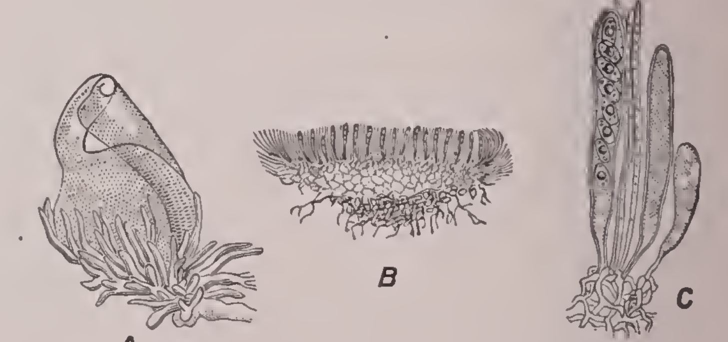


FIG. 5.—A, sexual organs of a cup-fungus ; B, section of mature fruit ; C, spore-sacs.

romycetaceæ), now considered to be greatly degraded members of this order (Fig. 7, B).

The Rusts (*Uredineæ*) may be regarded as greatly degraded parasitic sac-fungi, in which the spores at maturity entirely fill the spore-sacs (the "teleutospores" of descriptive botany). The plant is much reduced, and consists of branching threads which penetrate the tissues of its host, eventually producing summer-spores ("uredospores," or red-rust) and later the spore-sacs ("teleutospores," or black-rust). In many species there is still another spore-bearing stage preceding the red-rust, viz., the "cluster-cup" stage, which is probably to be regarded as strictly the original summer-spore stage. See RUSTS.

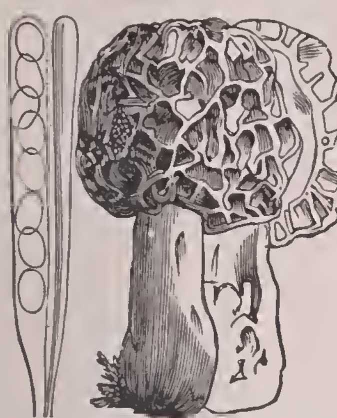


FIG. 6.—Common Morel (*Morchella esculenta*), with spore-sac at side.

The Smuts (*Ustilagineæ*) are parasites in which the structural degradation has proceeded still further than in the rusts, so that their true relationship is seen with the greatest difficulty. However, they may be regarded as sac-fungi whose spore-sacs are much distorted, or in many cases are so reduced as to form but a single spore. See SMUTS.

The so-called "Imperfect Fungi" are probably to be considered as members of the class of sac-fungi, although their method of spore formation is known only for the conidia (asexual spores). No less than 11,500 species are temporarily placed here awaiting full investigation. At present they are arranged under three orders, viz.: (1) *Sphæropsideæ*, in which there is a perithecium (but no spore-sacs), in which the spores are produced on the ends of threads (Fig. 9, A, B). Here are placed many of the most harmful parasites on cultivated plants, e. g. many species of *Phyllosticta* and *Septoria*, which produce diseased spots on foliage, stems, and fruits. (2) *Melanconieæ*, in which there is no perithecium, but the spores are produced subeu-

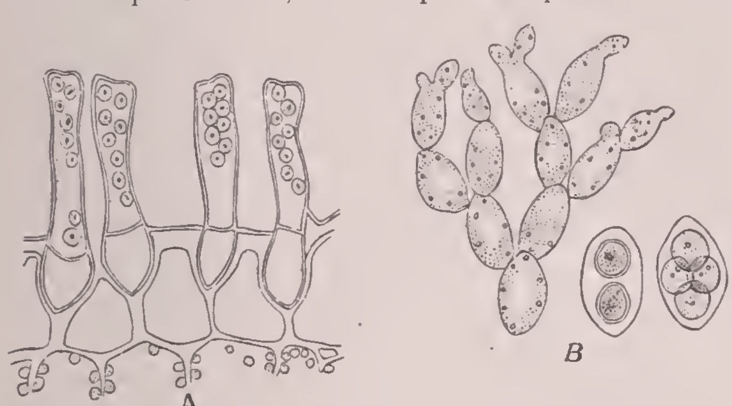


FIG. 7.—A, Exoascus of the Alder ; B, yeast-fungi, two cells with ascospores (highly magnified).

taneously on the ends of threads (Fig. 10). The genus *Glœosporium* contains many harmful species. (3) *Hyphomyceteæ*, in which there is no perithecium, but the spores are borne free upon superficial or sub-superficial threads (Fig. 11). Species of *Ovularia*, *Ramularia*, *Fusicladium*, *Cercospora*, etc., are quite injurious to many cultivated plants.

The Higher Fungi (*Basidiomycetes*) include somewhat more than 10,000 described species, many of which attain a considerable size. In all cases the plant is a mass of delicate threads (*mycelium*) ramifying through the organic matter (mostly dead) on which it feeds, and later producing large "fruits" (commonly supposed to be the plants themselves) in which are borne the spores. The numerous families are grouped into two pretty well-marked orders, viz.:

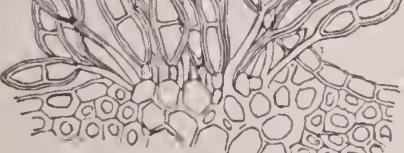


FIG. 8.—Spore-sacs ("teleutospores") of a rust, each containing two ascospores.

The Puff-balls (*Gasteromyceteæ*). Here the spore-bearing threads (basidia) are always internal, and the "fruits" (at maturity filled with dusty spores) are usually more or less globular. See PUFF-BALLS.

The Toadstools (*Hymenomyceteæ*). In these the spore-bearing threads are from the first external or soon become so. In the typical forms the "fruits" are more or less umbrella-shaped, and the spores are borne on the surfaces of radiating gills or vertical tubes. The common edible mushroom (*Agaricus campester*) and the ink toadstools (*Coprinus sp.*, Fig. 12) are familiar examples of the fruiting plants of this order.

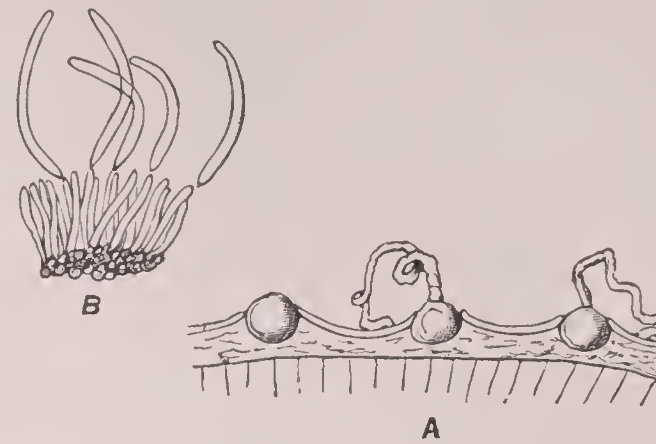


FIG. 9.—A, three perithecia of *Septoria* extruding masses of spores ; B, spores from interior of perithecium.

M. C. Cooké, the author of *British Edible Fungi*, speaks of the uses of fungi as follows: "In European countries the common mushroom (*Agaricus campester*) enjoys the widest popularity as an esculent, especially the cultivated varieties. The meadow mushroom (*Agaricus arvensis*) is scarcely inferior, though stronger in flavor, and is preferred by many to the cultivated species. In France the champignon (*Marasmius oreades*) is largely eaten, and in Austria *Collybia extuberans*, which has no admirers in England, finds a constant place in the markets during the summer. Truffles (*Tuber æstivum*, etc.) and morels (*Morchella esculenta*) are

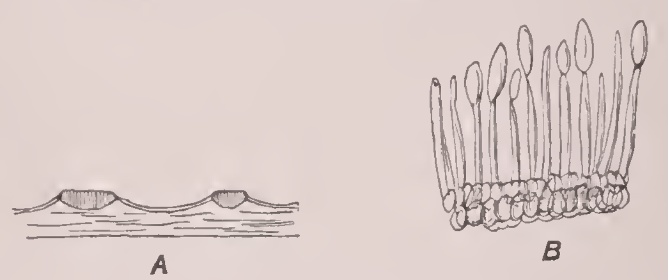


FIG. 10.—A, section through two spore-bearing spots of *Glœosporium* ; B, spores from the same.

favorites not only in Europe, but also in the vales of Kashmir, where two or three species of morels are dried for consumption throughout the year. The great puff-ball (*Calvatia maxima*) is increasing in reputation as a breakfast delicacy in Great Britain, while *Lactarius deliciosus*, the chantarelle (*Cantharellus cibarius*), and the hedgehog fungus (*Hydnum repandum*) have each their circle of admirers. Numerous other species are also eaten by mycophagists, although they are never found in the public markets. *Boletus edulis* cut in slices and dried may be purchased throughout the year in most of the continental cities. In Tahiti the Jew's-ear (*Hirneola auricula-judæ*) is dried in large quantities and exported to China, while a species of agaric (*Pleurotus subocreatus*) comes into the markets of Singapore, and another dried agaric (*Pleurotus fossulatus*) is sent from the Cabul hills into the plains of Northwestern India. Several species of Cyttaria are eaten in the southern parts of South America, and in Australia the *Mylitta australis* is a favorite article of food. In fact, a very long catalogue might be made of the species which are more or less consumed in different parts of the world; but we must rest content with suggesting some of the most important or interesting, referring the reader to more special treatises for further information. The cultivation of fungi for esculent purposes has not hitherto been successful with any other species than the ordinary mushroom. Attempts were made

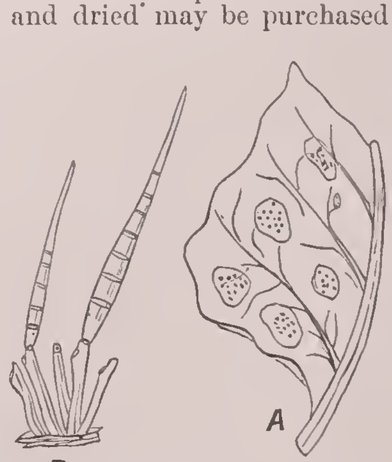


FIG. 11.—A, fragment of beet-leaf with spots of *Cercospora* ; B, spores of same (magnified).

in France for the cultivation of truffles, at first apparently with considerable promise, but ultimately without much satisfaction. There is no good reason to suppose it impossible or improbable that many species might be cultivated if proper care, time, and attention could be devoted to experiments in that direction. Fungi useful to man in medicine or the arts are by no means numerous or of importance. Some species of Polyporus have been employed as styptics, or beaten till soft and used as amadou. One species in Burma has a good reputation as an anthelmintic. Some species of Polysaccum and Geaster are employed medicinally in China. Species of Elaphomyces were at one time supposed to possess great virtues, now deemed apocryphal. Ergot still maintains its position in the pharmacopœia, but is almost the only fungus now employed (and that sparingly) by the legitimate medical practitioner."

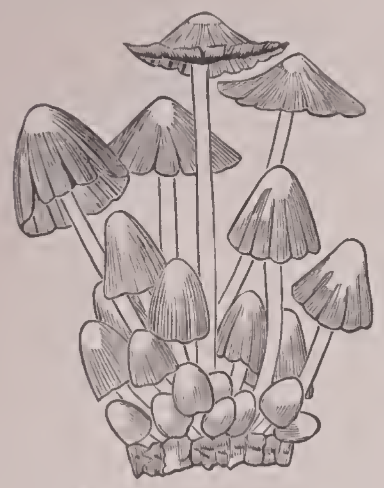


Fig. 12.—Fruiting plants of *Coprinus micaceus*, one of the ink toad-stools.

It is impossible within the limits of this article to enumerate the fungi which are injurious to cultivated plants, many of which are attacked by a great number of species. Thus wheat is the host of no less than 14 fungi, Indian corn of 67, the apple of 79. In economic mycology the injurious fungi are commonly referred to under the diseases which they produce, and will be so treated here. Accordingly the reader is referred to the following articles: Blight (on apple, pea, quince, strawberry, tomato, potato, and grape), Ergot, Leaf-spot (on cherry, plum, strawberry, etc.), Oïdium (on many leaves), Mildew (downy, on grape, lettuce, potato, etc.; powdery, on apple, cherry, grape, hop, pea, etc.), Peach Yellows, Peach Curl, Plum Knot, Plum Pockets, Rot (bitter-rot of apples and grapes, black-rot of apples and grapes, brown-rot of grapes, bird's-eye-rot of grapes, dry-rot of timber, plum-rot, potato-rot, root-rot of grapes, tomato-rot, white-rot of grapes, wet-rot of timber), Rusts (of apple, blackberry, Indian corn, raspberry, wheat, etc.), Scab (on apples, pears, etc.), Smut (on barley, Indian corn, oats, sugar-cane, wheat, etc.).

Aside from the bacteria, there are few fungi which are productive of diseases in animals. Quite a number are actively poisonous when eaten; in fact many which so closely resemble the edible species as to be frequently mistaken for them have been found to be fatally poisonous. Great care must always be exercised in the collection of wild species for eating.

Literature.—From the enormous mass of literature relating to the fungi, the following works are suggested to the student: Cooke's *British Edible Fungi* (1891); Cooke's *Microscopic Fungi* (1871); DeBary's *Morphology and Biology of the Fungi, Mycetozoa, and Bacteria* (1887); Ellis and Everhart's *North American Pyrenomycetes* (1892); Luerssen's *Handbuch der Systematischen Botanik*, vol. i. (1879); Saccardo's *Sylloge Fungorum*, 10 vols. (1882 to 1892); Scribner's *Fungus Diseases of the Grape and Other Plants* (1890); Smith's *Diseases of Field and Garden Crops* (1884); Ward's *Timber and some of Its Diseases* (1889); Zopf's *Die Pilze* (1890); also the volumes of *Grevillea* (London, England); *Hedwigia* (Dresden); *Journal of Mycology* (Washington, U. S.); *Revue Mycologique* (Paris)—periodicals devoted mainly to the fungi. Charles E. Bessey.

Fungicide: a preparation which is fatal to fungi, and which may be used for combating fungous diseases of plants and animals. Most fungicides contain copper or sulphur in some form. The most popular fungicides, especially for plant diseases, for which fungicides are mostly used, are those which are applied in water, either in solution or in suspension. Since the knowledge of fungous diseases of plants has so greatly increased, fungicides have come to be one of the chief instruments in agriculture. They are of particular use in all branches of horticulture. Various pumps have been devised for the application of fungicidal and insecticidal sprays. The best spraying-machine is the one which throws the finest spray to the greatest distance. If the material can be applied in a voluminous cloud-like mist the best results are to be expected. The value of any fungicide depends to a considerable extent upon the time and method of its application. Timeliness, thoroughness, and persistence are the essentials of success. The disease must be dispatched before it has become thoroughly established, or, better, it must be prevented from obtaining a foothold. For such common diseases as grape-mildew, apple-scab, pear-scab, and the like, the first application should usually be made before the leaves appear, and the material should be applied at intervals thereafter, as recommended for the various plants under their respective heads. The two most important fungicides at the present time are Bordeaux mixture and ammoniacal carbonate of copper. The former is more adhesive, but it is difficult to apply to tall trees unless much diluted. The latter is cheaper and more easily applied. The Bordeaux mixture can be added to such insecticides as Paris green and London purple, and insects and fungi may be combated at the same time. The following are the leading fungicides:

Ammoniacal Carbonate of Copper.—1. Into a vessel having a capacity of 2 quarts or more pour 1 quart of ammonia (strength 22° Baumé), add 3 oz. carbonate of copper. Stir rapidly for a moment, and the carbonate of copper will dissolve in the ammonia, forming a very clear liquid. The concentrated liquid thus prepared may be kept indefinitely. For use, dilute to 25 gal.

2. Carbonate of copper, 5 oz.; ammonia (26°), 3 pints; water, 45 gal. This is probably the better method.

It is better to wet the carbonate before dissolving it. For grape-rot and mildew, apple-scab, and many other diseases.

Ammoniated Copper Sulphate (mixture No. 5 of Department of Agriculture).—Equal parts of ammoniated copper sulphate and ammonia carbonate. Put 1 lb. of the material in 25 gal. of water when desired for use. For the same uses as ammoniacal carbonate of copper.

Bordeaux Mixture (copper mixture of Gironde).—1. Dissolve 6 lb. of sulphate of copper in 16 gal. of water. In another vessel slake 4 lb. of fresh lime in 6 gal. of water. When the latter mixture has cooled, it is slowly poured into the copper solution, care being taken to mix the fluids thoroughly by constant stirring. Prepare some days before use. Stir before applying. Stronger mixtures were at first recommended, but are not now used. Mixtures about half the strength of the above have been used with good reults.

2. Powdered sulphate of copper, 12 lb. in 15–20 gal. of water; lime, 8 lb. in 10–12 gal. of water. When the materials are thoroughly incorporated with the water, add the two mixtures.

For downy mildew and black-rot of the grape, blight and rot of the tomato and potato, blights of fruits, and many other diseases.

Sometimes the mixture is not washed off the grapes by the rains. In this case add 1 quart of strong cider vinegar to 5 gal. of water, and dip the grapes, allowing them to remain a few minutes, then rinse once or twice. Dip the grapes by placing them in a wire basket.

Eau Celeste.—1. (Audoynaud process.) Dissolve 1 lb. of sulphate of copper in 2 gal. of hot water. When completely dissolved and the water has cooled, add 1½ pints of commercial ammonia (strength, 22° Baumé). When ready to use, dilute to 25 gal. For treatment of downy mildew and black-rot of the grape, anthracnose, and blight and rot of the tomato and potato, and many other diseases.

2. Dissolve 1 lb. of sulphate of copper in 2 gal. of water. In another vessel dissolve 1 lb. of carbonate of soda. Mix the two solutions. When chemical reaction has ceased, add 1½ pints of ammonia, then dilute to 25 gal. For the same purpose as No. 1, and probably better.

Sulphate of Copper.—1. Dissolve ½ lb. of pure sulphate of copper in 5–12 gal. of water. For treatment of downy mildew and black-rot of grape and apple-scab in winter, or in spring before the buds swell.

2. Dissolve 5–8 lb. in 10 gal. of water. For soaking grains previous to sowing to destroy spores of smuts. The Germans use a ½-per-cent. solution, and soak the grains for about 16 hours.

Sulphide or Sulphuret of Potassium (liver of sulphur).—Simple solution in water of ¼ to 1 oz. to the gallon. For mildew in greenhouses, mildew on roses, gooseberry-mildew, orange-leaf scab, celery-leaf blight, pear and apple scab, and various rots.

Sulphide of Soda Wash (Hilgard's).—Dissolve 30 lb. of whale-oil soap in 60 gal. of water, by heating the two together thoroughly. Then boil 3 lb. of concentrated lye (American) with 6 lb. of sulphur and 2 gal. of water. When thoroughly dissolved, it is a dark-brown liquid, chemically sulphide of soda. Mix the two—soap and sulphur—boil for half an hour, add 90 gal. of water, and the mixture is ready for use. Apply warm with a pump For scab diseases.

Sulphur.—In its dry and pulverized state, sulphur, known as flowers of sulphur, is often a valuable fungicide, particularly for surface mildew. In the greenhouse it may also be used in fumes. Evaporate it over a steady heat, as an oil-stove, until the house is filled with the vapor. It should never be heated to the burning point, as burning sulphur quickly destroys most plants. It may also be used in water, in the proportion of an ounce of sulphur to 5 gal. of water. See also INSECTICIDE. L. H. BAILEY.

Fŭng-shui, or **Fêng-shui**, fŭng-shwee (Chinese, literally, wind and water): a kind of geomancy in universal use in China (1) for determining the luckiness or unluckiness of particular spots, and hence much in vogue in selecting suitable sites for cities, houses, temples, graves, etc.; and (2) in overcoming inauspicious conditions as regards aspect or the conformation of the ground in the neighborhood when the site is otherwise auspicious. The term is also used to designate the geomantic conditions themselves, as when it is said that the fung-shui of a place is bad, i. e. is such as will involve misfortune or death unless improved by such remedial measures as raising a mound or building a pagoda, planting trees, or in some other way altering the conformation or mutual relations of the surrounding hills, valleys, etc., which are but the outward manifestations of nature's breath as it pulsates in its twofold male and female forms through the earth, now expanding and now reverting, according to the fixed order of nature. A southern aspect is the best, for all good influences come from the south, and all evil influences from the north. Whatever tends to bar the way against these good influences, or to open the way to these evil influences, must be avoided. Hence the opposition hitherto shown by the Chinese to the introduction of railways and telegraphs, and to the opening of mines, which might endanger the "aspects" of countless graves and dwellings. Straight lines, especially when pointing to a proposed site, pointed gables, abrupt or rugged elevations with sharp peaks, and the like, are unfavorable; while a gradual slope, gentle curves, and crooked lines are auspicious. Uniformity of conformation or of façade must be avoided. To build on a hill resembling a basket, a plowshare, a turtle, the eye of a horse, or the like is very dangerous. Premature and violent death awaits the sons and grandsons of the man who builds on a hill which resembles a couch, while his daughters will always be ill, and his sons will spend their days in prison, if he build on an elevation which resembles a boat turned bottom up, and childlessness will be the lot of all connected with him if he build on a hill having the general outlines of a bell, surmounted by the outlines which correspond to the planet Venus. The most auspicious spot for a grave is where the Yang and Yin, or male and female principles of nature, meet, forming a kind of horseshoe with the "Azure Dragon," or male principle, on the east or left (according to the Chinese the magnetic needle points to the south), and the "White Tiger," or female principle, on the right or west. A side-hill is a desirable location, but an open plain or the top of a mountain is not. A burial-place judiciously chosen with reference to these and numerous other points, which the professional geomancer has to consider, will insure wealth, honor, distinction, and long life to the posterity of the person buried there. Interment is often postponed for many months while search is made for the lucky spot.

Little has been written on the subject by foreigners, but there is a considerable native literature, beginning with the *Tseh-king* or Dwelling Canon, dating from the first century of our era. See Doolittle's *Social Life of the Chinese* (vol. ii., p. 337, New York, 1865); *Notes and Queries on China and Japan* (vol. i., pp. 7, 9, and 19, and vol. ii., p. 69); *The Chinese Recorder* (vol. i., p. 39, Fuh-chow, 1867); Eitel's *Feng-shui: or the Rudiments of Natural Science in China* (London, 1873); and Edkins's *Chinese Buddhism*, pp. 327–352 (London, 1880). R. LILLEY.

Funk, FRANZ XAVER, von: See the Appendix.

Funk, ISAAC KAUFMANN: See the Appendix.

Fur [*fur* < M. Eng. *furre*, from O. Fr. *fuerre*, sheath, case, from Teuton.; cf. O. H. Germ. *fuotar*, lining, case (> Mod. Germ. *Futter*, lining): Goth. *fodr*, scabbard < Teuton. *fodr-* < Indo-Eur. *pātr-* > Sanskr. *pātra*, dish]: the short fine soft coat or covering of some animals, as the beaver, ermine, otter, seal, etc. What is called fur is in general shorter, finer, and softer than hair, but there is no definite line of distinction. The use of the skins of wool-bearing and fur-bearing animals as convenient and readily adapted clothing goes back, according to the sacred records, to the time of the expulsion of the first pair from Eden. This costume is used among all savage and half-civilized nations in cold climates, and some of those in semi-tropical regions. But apart from the use of these skins of animals as clothing, there grew up at a very early date a demand for the finer and more beautiful furs for purposes of ornament and luxury. They were used for the decoration of the tabernacle in the wilderness. Costly furs formed a part of the luxurious coverings of couches in the palace of Sardanapalus. Herodotus tells us that the inhabitants of the shores of the Caspian Sea were clad in the rich fur of the seal, and Ælianus and Plutarch both speak of the Pontic mouse (generally supposed to have been the ermine), whose rich fur made warm and beautiful robes, and was used as the covering of couches in the palace of Pharnabazus. The Chinese and Japanese have used furs as articles of luxury for at least 2,500 years (the Chinese probably more than 3,000), and the robes of ermine, sable, and fiery-fox furs worn by the nobles of both nations are remarkable for their beauty. The choicest and finest furs were very generally worn as articles of luxury by the Roman aristocracy in the decline of the Roman empire. The tribes of Goths, Huns, and Ostrogoths which migrated in hosts from the north carried with them the choice furs of the Arctic regions, and during the Middle Ages they became articles of luxury throughout Southern and Central Europe. In the wars with the Saracens the Christian princes imitated their foes in their habits of luxury, and costly furs from the East were used to such an extent that they well-nigh ruined the nations of Europe. Sumptuary decrees were issued about A. D. 1200 by Richard I. of England and Philip II. of France, prohibiting the wearing of these costly furs either by princes or people, but before the close of that century Louis IX. of France appeared in public with a surcoat lined with the skins of 746 ermines. Not long after this the privilege of wearing particular kinds of choice furs was granted to certain noble families in Germany, France, and Italy, but each one was restricted to a single kind of fur, and was permitted to put a figure of the animal producing it in his armorial bearings. Thus the ermine, the sable, the Hungarian squirrel, the Podolian or fiery fox, and possibly also the beaver and the wolf, came to find a place in the coats-of-arms of some of the highest aristocracy of continental Europe.

The furs principally worn are those of the Alaska seal or sea-otter; the fur-seal, of which not over 300,000 are taken annually; the sable, usually called the Russian sable, though the finest specimens come from Northeastern Siberia or Kamchatka. The fur of this animal is distinguished from all other furs by the hairs turning and lying equally smooth in either direction; this may be tested by blowing it. It is of a rich dark brown, approaching black. A fine set of these furs ranges from $800 to $1,800. The kolinski or Japanese sable is more plentiful, but is almost wholly taken up in the European, and especially in the British, market. The pine marten or Hudson Bay sable is still more abundant; its color is a lustrous brown, and it is sometimes colored and passed off as the Russian sable. The stone marten is of inferior quality, and of yellowish-brown color. It is often colored in Europe where it is much used. The fisher marten is a scarce and valuable fur, and is sold mostly in Europe. The mink is a favorite fur in the U. S. The best specimens are a dark chestnut brown, approaching to black, and resemble the Russian sable in color and fineness. The greater part are somewhat lighter in color, and the poorest are of a yellowish-brown hue. The ermine, called in Great Britain the stoat, is very abundant in the northern portions of America, Europe, and Asia. It is pure white in winter, except the tip of its tail, which is jet black; in summer it is yellowish brown. Its fur was once only allowed to be worn by the highest nobility and on the official robes of judges and magistrates. The fur of the skunk is fine, and that portion of it which is black is very beautiful. These are the principal furs sold in the form of collar, boa, and muffs: the sealskin and sea-otter are also made up in ladies' jackets, gloves, and caps, and in gentlemen's caps, collars, and gloves. These also are the only furs which are dyed successfully and retain both their color and gloss. Cheaper fur sets are made of Siberian squirrel, a very pretty slate-colored fur, muskrat, French rabbit or coney, common rabbit, wild-cat, house-cat, and occasionally of badger, Virginia opossum, or raccoon. The greater part of these skins are, however, exported to Germany and Poland, where they are largely used for trimming overcoats. The muskrat fur is mostly employed in the hat manufacture. A cheap imitation of sealskin is made from this fur by dyeing. The choicer grades of fox furs are used to some extent for trimming, but very rarely, if at all, for muffs, collars, or tippets. The color of the white fox is only white in winter; in summer he is brown, gray, or bluish, and is then called a cross or pied fox. The choicest of all the Arctic varieties of fox is the silver fox. Its color when in prime fur is a deep, glossy bluish black, with a silvery grizzle on the forehead and flanks. One of these skins has been sold for $500 in London. The skins of the different species of bears, wolves, Canada lynxes, badgers, panthers, and wild-cats, as well as those of the buffalo, are made up into carriage robes, and are in great demand.

When brought to the manufacturers, the pelts have been usually merely stretched and dried by the captors, or possibly a solution of alum has been applied to the flesh side. If not to be manufactured immediately, they are strewn with camphor, protected from dampness, and every few weeks carefully beaten with a stick. When they are to be dressed for making up into muffs, collars, etc., they are placed in tubs with a quantity of rancid butter and then trampled by the bare feet of men until the pelt is softened and partially tanned. They are next scraped on the flesh side with a strip of iron to remove portions of the flesh or cellular tissue which have adhered to the skin, and the grease is removed by trampling them again very thoroughly with fine sawdust of mahogany, lignum-vitæ, or some other hard wood. They are next beaten many times and the fur combed out. They are then ready for cutting out and making up into the various patterns of collars, boas, muffs, jackets, caps, gloves, etc.

Fürbringer, für'bring-*er*, Max, M. D., Ph. D.: anatomist; b. at Wittenberg, Saxony, Jan. 30, 1846; educated at the Latin School (gymnasium) of Gera, and at the Universities of Jena and Berlin. He devoted himself particularly to the study of zoölogy and anatomy under Haeckel, Peters, W. Müller, and Gegenbaur. He was successively assistant in anatomy under Gegenbaur, prosector, and later on Professor Extraordinarius of Anatomy at Heidelberg. From 1879 to 1888 he was Professor of Descriptive and Comparative Anatomy and Embryology and director of the Anatomical Institute of Amsterdam, and since 1888 he has held the same positions in Jena. Among the many important papers by Prof. Fürbinger may be mentioned *Knocken und Muskeln der Extremitäten bei den schlangenähnlichen Saurien* (Leipzig, 1870); *Zur vergleichenden Anatomie der Schultermuskeln* (Leipzig and Jena, 1873–75); and *Zur Lehre von den Umbildungen der Nervenplexus* (Leipzig, 1879). His chief work, however, is *Untersuchungen zur Morphologie und Systematik der Vogel* (published in two folio volumes at Amsterdam in 1888). This exhaustive treatise on the morphology and systematic classification of birds is the most important work on the subject that has yet appeared, and, full as it is of anatomical information, it must ever remain a monument to the knowledge and untiring industry of its author, and an indispensable aid to the student of avian anatomy.
F. A. Lucas.

Furetière, Antoine: lexicographer and satirist; b. in Paris, 1620; studied canon law and became Abbé of Chalivoy; wrote some successful satires, and in 1662 was admitted to the Academy, where his sharp tongue made him enemies. For many years the Academy had been collecting materials for a dictionary of the French language, and Furetière was accused of stealing from these stores for the similar work which he had in preparation. He was expelled from the Academy in Jan., 1685, on the charge of plagiarism, and mercilessly attacked by Charpentier, one of the Academicians. Furetière avenged himself on the Academy by his satire *Couches de l'Académie*, and retorted to Charpentier in *Factums*, which ran through four editions. He did not spare his former friend La Fontaine, whom he treated with injustice. But, on the whole, the public and the court sympathized with the satirist in his controversy with the Academy. D. May 14, 1688. His chief work was his *Dictionnaire Universel de la Langue Française*, published two years after his death. He claimed to have spent forty years of labor on this book. Among his other works *Le Roman Bourgeois* (1666) is valuable for the knowledge that it affords of the everyday life of his contemporaries. He also wrote *Poésies*; *Fables Morales et Nouvelles* (1666); and *Voyage de Mercure* (1673). F. M. Colby.

Furies, or **Fu'riæ**: See Eumenides.

Fu'rius: the name of many Roman historical characters, mostly of the old patrician gens Furia; but some plebeians bore the name also. The gens was very old. Of its origin nothing is known; the name is common on inscriptions of Tusculum, from which it has been inferred that the gens came to Rome from that place. The most famous of all was L. Furius, a prætor who overthrew the Gauls in the great battle of Cremona (200 b. c.) and received a triumph.
Revised by George L. Hendrickson.

Furius, Aulus, frequently called **Furius Antias**: a Latin epic poet who flourished about 100 b. c. A few short fragments are given by Bährens in his *Frag. Poetarum Romanorum* (Leipzig, 1886). See also R. Büttner, *Porcius dicinus und der litterarischer Kreis der 2. Lutatius Catulus* (Leipzig, 1893, p. 180). M. W.

Furius, Marcus Furius Bibaculus: a Latin poet of some eminence, who was b. in Cremona about 103 b. c., and lived as late as 24 b. c. He wrote lampoons, hendecasyllables in the manner of Catullus, and one or more epics. Horace (*Sat.* i., 10, 36, and ii., 5, 40) appears to have ridiculed his inflated style. See Bährens, *Frag. Poet. Rom.* (pp. 317–319). M. W.

Furlanetto, foor-lăa-net'tō, Giuseppe: successor in Latin lexicography to Facciolati and Forcellini; b. in Padua, Aug. 30, 1775; was educated at the seminary in Padua; became corrector of the seminary press; professor in the College of Sta. Justina; teacher of church history in the seminary; Professor of Hermeneutics in the university; and finally director of the seminary. In 1816 he published two fasciculi of additions to the lexicon of Forcellini, and then undertook a thorough revision of the whole work, which was published in 4 vols. (4to, Padua, 1823–31). D. Nov. 2, 1848. Revised by Alfred Gudeman.

Furlong [M. Eng. *furlong*, *furlang* < O. Eng. *furlang*, *furlung*, liter., a furrow long; *furh*, furrow + *lang*, long]: 40 rods in linear measure; the eighth of an English or U. S. statute mile, corresponding to the *stadium*, which was the eighth of a Roman mile. There are also several local furlongs, and the word is sometimes used for the name of a square or land measure.

Furnace [M. Eng. *fornais*, from O. Fr. *fornaise* > Fr. *fornaise* < Lat. *for'nax*, deriv. of *fur'nus*, **for'nus*, oven, deriv. of the root of *for'mus*, warm: Sanskr. *dharmá*: Gr. θερμός: Eng. *warm*]: in general, any structure or inclosed place in which heat is generated by the combustion of fuel for a particular purpose; specifically, a structure of iron or brick lined with some refractory substance, as fire-brick, for the generation of intense heat for use in some process of the industrial arts, especially in the treatment and utilization of metals and minerals. While special varieties of heating apparatus will be described or referred to in articles on manufactures wherein such apparatus is employed, the general principles of furnaces, and their classification according to the methods of utilizing fuel, are subjects of sufficient individuality and magnitude to warrant a separate essay; and as nearly all important types of furnaces are employed in the iron and steel manufacture, the illustrations will be drawn from this source. Furnaces may be classified as follows: I. According to the methods of applying heat. (1) *Open fires*, in which the material under treatment is heated in the fuel-chamber either in contact with the fuel or with the heat radiated directly from it, or with both. Iron-smelting or blast furnaces are of this class, but as complex chemical processes other than those generating heat takes place in them, they are better referred to in a separate article. The different kinds of furnace used for heating steam-boilers are of this variety. (See the article Steam-boiler.) The metallurgical furnaces of this class are the cupola for melting iron for castings, etc.; the smith's "fire" in all its forms; the pot furnace for melting steel in crucibles; also the usual forms of cementing furnaces. In pot and cementing furnaces the vessel that holds the metal, rather than the metal itself, is in direct contact with the fire. All forms of apparatus for heating air for domestic, metallurgical, or manufacturing purposes, by means of conducting walls placed between the heat-imparting medium and the air to be heated, are properly classified as "stoves," and are treated in various articles referring to the warming of buildings, also under the head Blast Furnace. The Bessemer converter and the "sponge" or ore-reducing furnace are of this class, and will be treated under STEEL. (2) *Reverberatory furnaces*, in which the material under treatment is heated in a chamber separate from and adjoining the fuel-chamber by means of the hot gaseous products of combustion and by radiation from the heated walls of the chamber. Most of the furnaces used in the wrought-iron and steel manufacture are of this class. The principal varieties are the puddling furnace, the "heating" furnace, the open-hearth or Siemens-Martin steel furnace, and the "air" furnace, which is a reverberatory melting furnace.

II. Furnaces are further classified according to the method of utilizing the fuel: (1) *Coal furnaces*, in which the heat utilized is the *direct* product of the combustion of solid fuel. (2) *Gas furnaces*, in which the fuel enters the furnace in the form of a gas; in metallurgical furnaces this is chiefly carbonic oxide; if bituminous coal, wood, or peat is employed, some hydrocarbons are present. To say that in the coal furnace fuel is used where it is burned, and that in the gas furnace fuel is made into gas in one place and used in another, would not accurately distinguish between the two varieties, because the gas-producer may be a part of the furnace where the heat is utilized, and yet the combustion which produces the carbonic oxide gas may be a distinct chemical process from the combustion which generates the utilized heat. The blast furnace and the cupola are necessarily coal furnaces; the other furnaces enumerated, whether the heat is applied in the chamber where combustion takes place or in an adjoining chamber, may be either coal or gas furnaces.

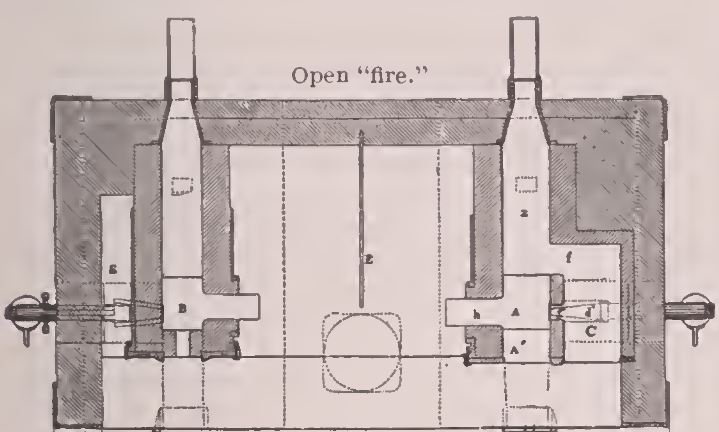


FIG. 1.—Horizontal section

Description of Furnaces.—Of the *open fires*, the smith's fire or forge is the oldest and the most common. It consists, in its simplest form, merely of a pile of coal from 1 to 2 feet in diameter, beneath which a blast is forced through a tuyere leading from a hand-bellows. Iron or steel bars inserted in the fire may receive a welding heat. In large smith-shops, such as those connected with extensive machine-shops, these fires, sometimes fifty or more in number, are arranged in a suitable building, each with its blast-pipe from a common power blowing-machine, and its water-bosh, anvil, and other appurtenances, and its chimney or a flue leading to a common chimney. The fire is usually placed on a cast-iron table, or rather a shallow tank on legs, at a

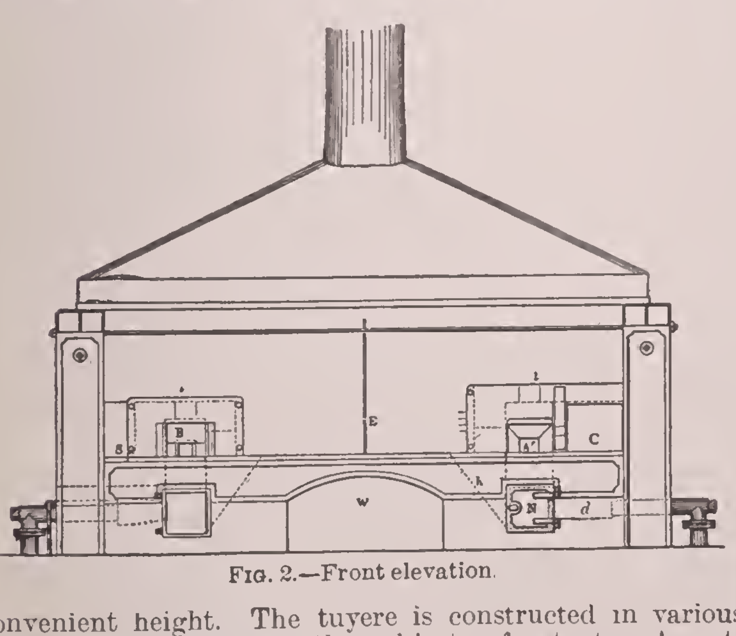


FIG. 2.—Front elevation.

convenient height. The tuyere is constructed in various ways, many of which are the subjects of patents. A portable smith's forge is usually a light iron stand holding the platform for the fire, and also some form of hand blowing-machine and a water-bosh. The portable forge is chiefly used for heating rivets for ship and boiler work. A more elaborate form of open fire is shown in horizontal section by Fig. 1, and in front elevation by Fig. 2. It is largely employed in crucible steel works for heating small ingots and bars. The "cold" or cogging fire consists of a pit, A, 14 by 16 inches in plan and 2 feet deep, without grate-bars, in which the fire is urged by a blast entering the tuyere, *d*. The ashes are withdrawn at N, and the ingots are inserted at A′, having been previously warmed in the "smoke-hole" C, into which flame enters at *f f*. Coal is fed down the incline *h* into the pit A. The extension Z is for the accommodation of long bars. The gaseous products of combustion pass, partly and in a regulated degree, into the general chimney through the holes *l l*, and partly through the mouths and feed-holes of the fires. The water-bosh is placed under the arch W, and the coke and coal for use lie on the platform above it, being divided by the partition E. The "hot" or welding fire, B, is a pit 16 by 12 inches in plan, and otherwise similar to the cogging fire. Its tuyere is protected by a water-casing. The fuel is coke. S is an iron tray containing welding sand. The fire-pits are built of fire-brick, the most refractory kind being required in the welding fire, where the most exposed parts last but a month. The two fires consume about 15 bush. of coal and 15 bush. of coke in nine hours to heat and reheat 45 cwt. of steel. Casting the ingot in an iron mold chills its surface, so that sudden heating would "burn" it. It is therefore warmed slowly in the smoke-hole, then heated in the cogging fire, and partially drawn under a power-hammer; then it is reheated as often as required in the welding fire.

The earliest smelting furnaces were open fires, not much larger than smiths' forges, and the same crude apparatus is still employed where fuel is plentiful both for smelting ore and for decarburizing crude cast iron.

The *reverberatory heating furnace* for solid fuel, as employed for heating iron and steel masses of 300 to 5,000 lb. weight, is shown in vertical section by Fig. 3. The fire on

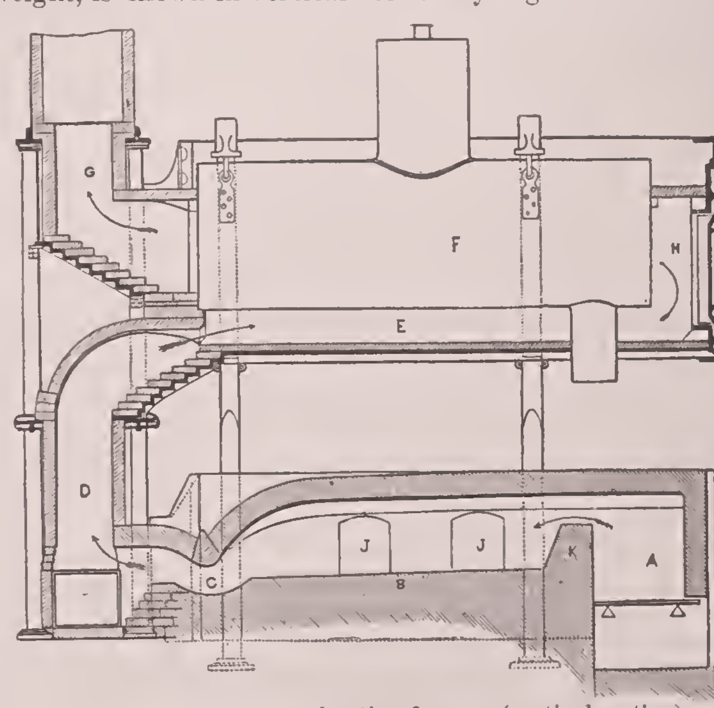


FIG. 3.—Reverberatory heating furnace (vertical section).

the grate A is urged by the draught of a high chimney, or usually by a power-fan. The masses to be heated are inserted and withdrawn through the doors J by hand, or by machinery if they are very heavy. The bottom of the furnace is a bed of sand, which is compacted by partial fusion. The metal is separated from the fuel and shielded from the direct impact of the flame by the bridge K. The flame, passing along under the roof of the furnace, heats the metal below, partly by contact and partly by radiation. The flame-current is "reverberated" by the roof and sides, so as to roll down upon and over the metal. The contracted throat C tends to check the expansion, and hence to maintain the temperature of the burning gases at this point, although the furnace "works" hotter at the bridge than at the throat. The shape of the roof, the size of the throat, and the height of the bridge are the subjects of endless modifications to suit the nature of the work and also the caprices of the workmen.

Cinder that forms from the oxidizing metal and the melting sand-bottom when high heats are employed accumulates and is tapped off at C. The furnace is a strongly bound iron shell lined with fire-brick. Upon a bed 10 to 12 feet long, six 7 by 7-inch iron rail piles can be heated to welding in $1\frac{1}{2}$ hours with about 1,000 lb. of coal per ton of iron. The engraving also shows one of the various arrangements of boilers for utilizing the waste heat of the furnace. The boiler F and its brick casing are placed over the furnace (to save room), and upheld by iron columns. The hot products of combustion pass up the flue D, under the boiler at E, and through the boiler flues into the chimney G. The tubes are accessible for cleaning through the doors H. In mills for rolling iron rails all the steam for driving the engines may be generated by the waste heat from the furnaces. Steel-heating furnaces are worked at a lower temperature, and the boilers over them do not furnish all the required steam.

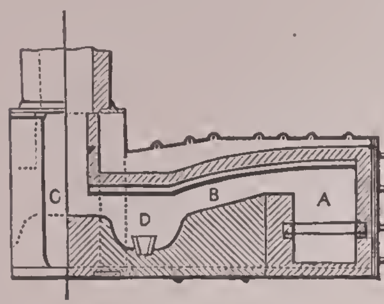


Fig. 4.

The reverberatory melting furnace, or "air" furnace for solid fuel, is of similar construction. In the older form (Fig. 4) the flame and any free air it may contain are drawn from the fire-box A along the roof of the furnace, and do not come in direct contact with the metal lying on the bed B. In the later form (Fig. 5) the flame from A is thrown by the roof directly upon the iron lying at B. This furnace therefore melts faster, but it oxidizes the metal more rapidly. The average air-furnace melts 2 tons of pig iron with a ton of coal. In European practice reverberatory melting and heating furnace fires are maintained by the draught of large and high chimneys. The same is true of the reverberatory furnaces almost universally employed in the U. S. for melting iron for cannon and rolls. But in the later foundry and rolling-mill practice fires are maintained more uniformly and with less expense by blast from power blowing-machines, usually rotatory high-speed fans. Iron melted in an air-furnace, as compared with that melted by direct contact of fuel in a cupola, escapes contamination by the sulphur in the fuel, and its carbon and silicon may be oxidized to any extent required for castings in the air-furnace, thus increasing its strength. The practice of melting 5 to 20 per cent. of soft steel scrap, as required, with cast iron in the cupola is found to make castings equally strong for many purposes.

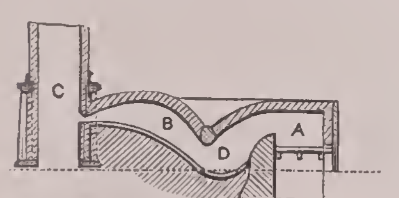


Fig. 5.

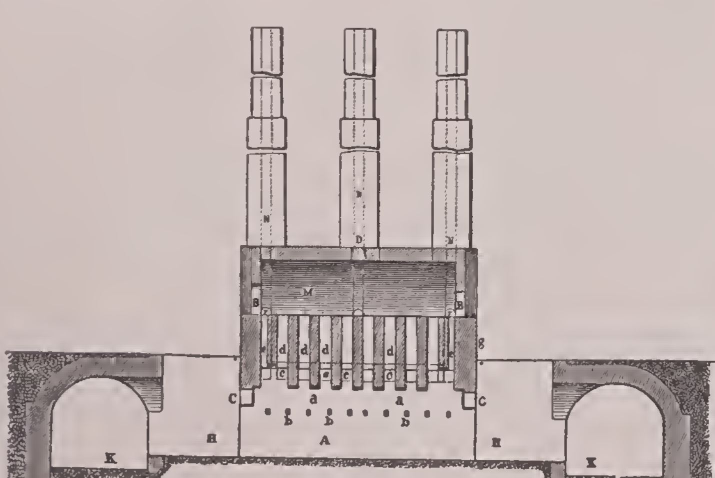


Fig. 6.—Cementing furnace (vertical section).

The cementing furnace is shown in vertical section by Fig. 6, and in horizontal section by Fig. 7. It is employed for heating wrought iron in contact with carbon to make carburized iron, called "blister steel," which is then rolled into marketable shapes or broken up and melted in crucibles to make cast steel. The same general type of furnace is suitable for annealing metals and for reversing the operation of cementing—viz., heating bars or castings in contact with oxide of iron to withdraw carbon. The furnace consists of two pots or troughs of refractory material (defined in Fig. 7 by the letter G at the four corners of each pot), each about 13 by 4 feet in plan and 4 feet deep, capable of

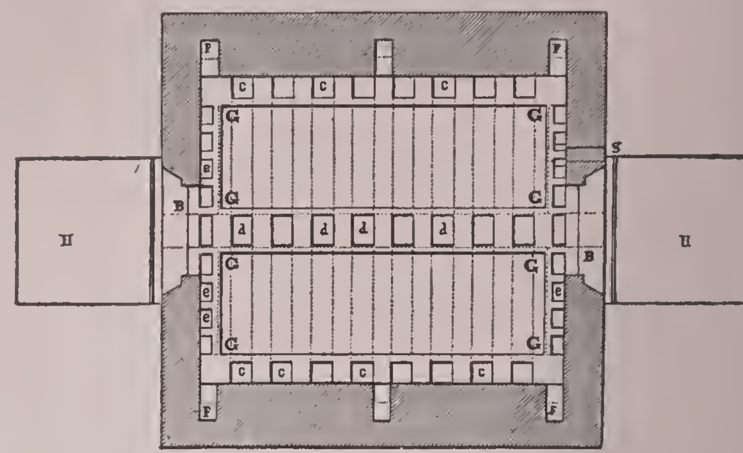


Fig. 7.—Cementing furnace (horizontal section).

holding 15 tons of iron bars. The pots are surrounded and heated by means of numerous flues, *c*, which pass under the bottom and up the sides, and flues *d e*, all of which convey flame from the common fire A to the chamber *m*, whence it is discharged by the chimneys N. The fire-grates lie on the bearing bars *a* (Fig. 6), and form a fireplace about 16 inches wide and 18 feet long. The large doors B B give access to the pots. H H are pits at each end of the furnace for working the fires, and K K are tunnels connecting the pits of a series of furnaces through which fuel is brought and ashes are removed. Layers of charcoal about one-fourth of an inch thick and layers of iron bars are laid alternately in the pots (in such manner that no bars shall touch each other) until the pots are full. Then sand and a cover of fire-clay is tightly rammed upon each pot, and the doors B B are closed with brick walls, except a sight-hole in each. A fire is then built upon the grate at *a*, and a yellow to white heat is maintained on the pots for six to ten days, according to the degree of carburization required. Test bars are from time to time withdrawn at the hole *g* to ascertain the progress of the cementation, and when it is completed the ash-pit doors are closed and the fire is allowed to smolder and go out. The pots are then opened and the bars are removed. Furnaces for heating-retorts in the production of illuminating gas are simpler forms of the above-described apparatus.

The cupola furnace, in a form commonly used for melting iron in foundries, is shown in vertical section by Fig. 8. It consists of a plate-iron shell lined with fire-brick. The internal diameter is ordinarily from 3 to 6 feet. The engravings show a Mackenzie cupola, which is elliptical in cross-section in order to shorten the travel of the blast from the tuyere B to the center of the cupola. The tuyere is a slit 1 inch to $1\frac{1}{2}$ inches high, and extending entirely around the furnace. Air is supplied through the wind-boxes D from a high-speed fan or a piston blowing-machine at a pressure of $\frac{3}{8}$ lb. to 1 lb., according to the amount and duration of the work. The furnace is narrowed at the melting zone by the boshes C. Iron (either pig or cast scrap) and anthracite coal or coke are charged in alternate layers, and the melted metal accumulates in the hearth below the tuyeres, and is tapped off at A. Bituminous coal, being compacted by the heat and the pressure of superincumbent charges, will not permit free passage of the blast, and is hence an unsuitable fuel for cupolas. From 5 to 15 lb. of iron are melted with a pound of coal, according to the kind and size of furnace. When the day's melting is over the bottom doors are opened and the sand bottom and the slag and any remaining iron are dropped into the pit below.

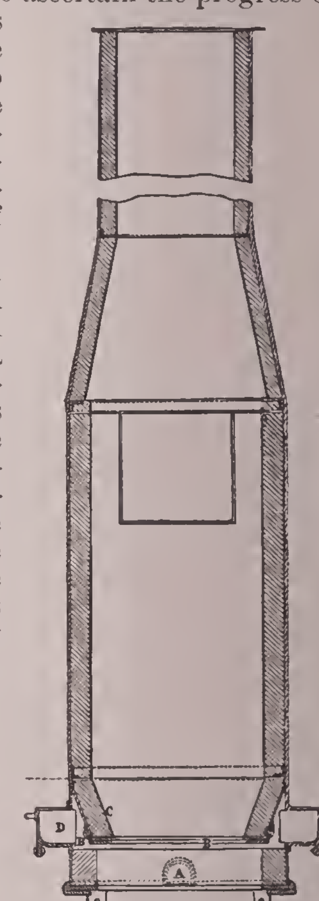


Fig. 8. — Cupola furnace (vertical section).

For delivering regular quantities of melted iron for many consecutive hours—for instance, 6 tons an hour for a day and a night in the Bessemer steel-works—modifications of the cupola are required, as shown in the vertical section Fig. 9 and the cross-section Fig. 10. In the foundry cupola (Fig. 8) the hearth is shallow, so that the bed-charge of coal (which must reach above the tuyeres) may be light; and since the furnace is run but a few hours at a time, this hearth is large enough to contain the slag. If a great quantity of iron is required, large cupolas or a number of cupolas are employed. But when the furnace must melt continuously for many hours, the hearth H (Fig. 9) is enlarged to accommodate a considerable quantity of melted metal and slag, and the tap-holes U V are provided to discharge the slag as it accumulates; otherwise it would rise and clog the tuyeres and form "scaffolds," which are masses of slag and coal that chill upon the walls. The tuyeres O are cast-iron tubes, generally six in number, with a 5 by 8-inch hole in each, and are so arranged that they can be cleared while in operation by inserting a bar through doors in the wind-boxes P. In a cupola of 5 feet internal diameter the bed-charge of coal, to reach above the tuyeres, is about $2\frac{1}{2}$ tons. Upon this are placed $3\frac{1}{2}$ tons of pig iron and 100 lb. of limestone (to make the cinder fluid); then 600 to 700 lb. of coal, $3\frac{1}{2}$ tons of iron, and 100 lb. of limestone, followed by coal, iron, and limestone in the last-named proportions. The fire is maintained by draught through the holes J K L till the bed-charge is thoroughly alight; these holes are then closed and blast is applied through the tuyeres O. When some 15 tons of iron have been melted and tapped out at L, the slag-hole U is opened. As the hearth fills again with iron the slag floating upon it runs out; and when the iron has risen to U, it is again tapped off at L. The slag-hole now remains open, and the cupola is worked continuously as last described.

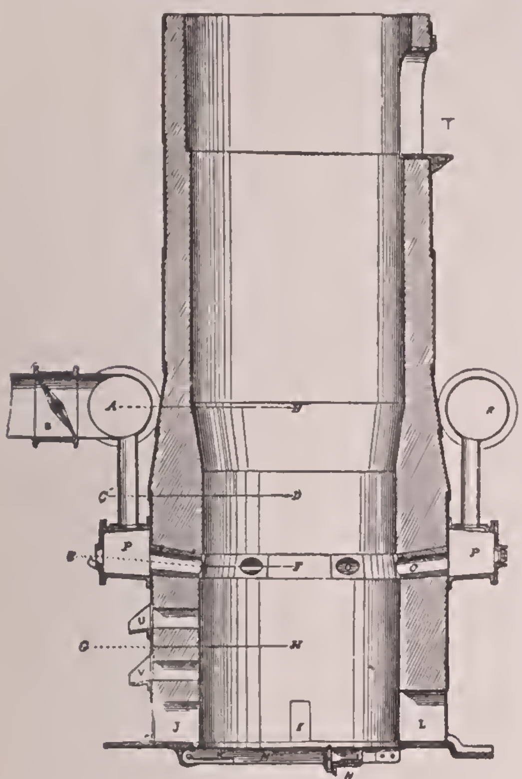


Fig. 9.—Vertical section.

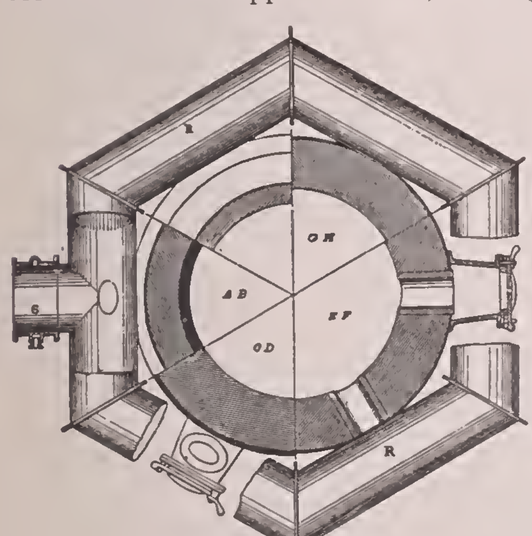


Fig. 10.—Cross-section.

The Gas-furnace.—The mere mingling of combustible gas and air is but one element in the production of the great and manageable heats obtained in a gas-furnace. The regenerative principle—i. e. utilizing the otherwise waste escaping heat to raise the temperature of the entering air and gas—is the subject of those modern improvements which are bringing the gas-furnace into almost universal use. There are two systems of regeneration: 1, the one by means of which Messrs. C. W. and F. Siemens, of London, developed the highly perfected and generally used Siemens furnace. This consists in passing the heated products of combustion, as they leave the furnace, over vast surfaces of brick, upon which they deposit their heat. The entering air and gas are then passed over these hot brick surfaces, and, so to speak, wash off the heat from them and

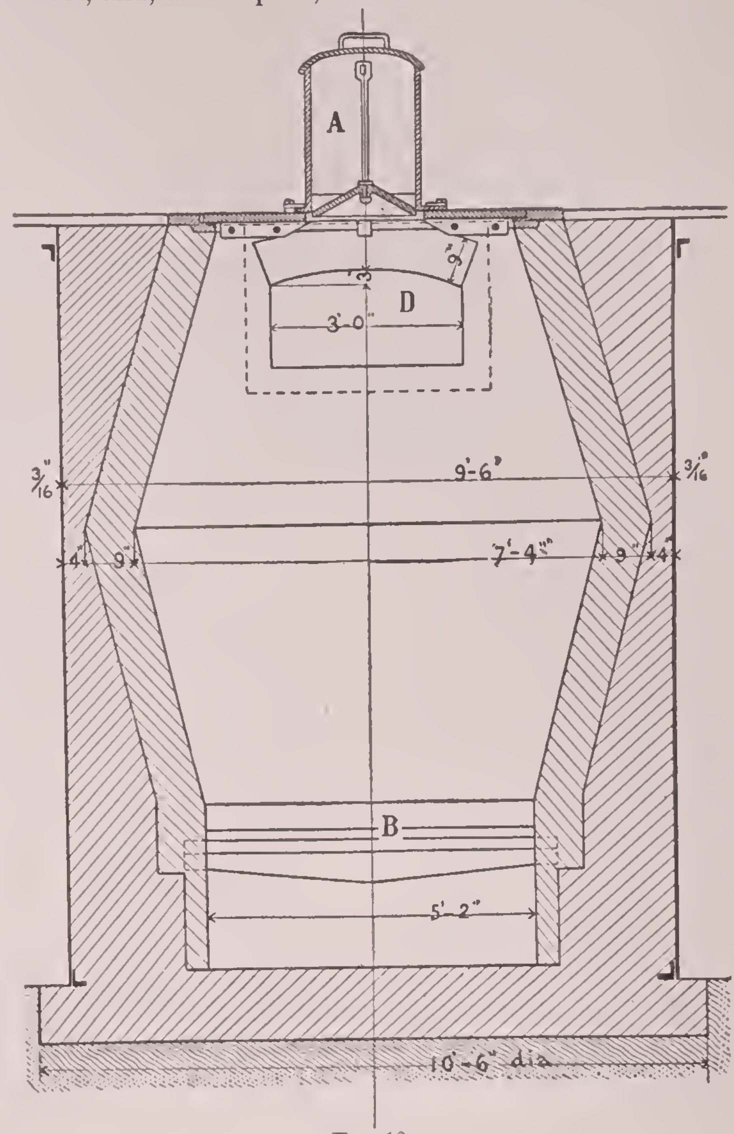


Fig. 10A.

take it up themselves. Meanwhile, the escaping products of composition are heating other brick surfaces, which

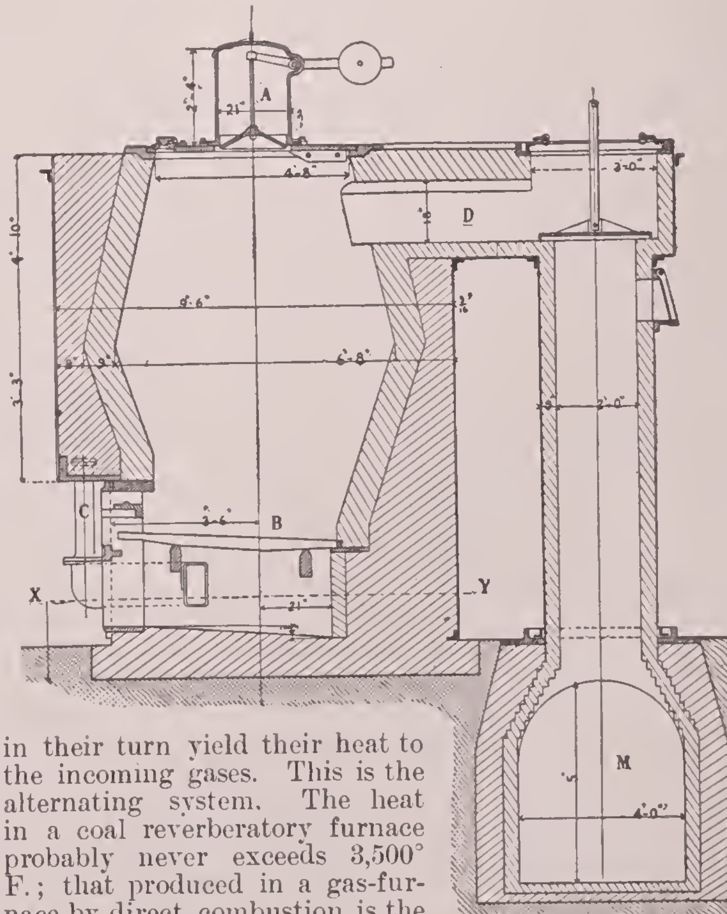


Fig. 10B.

in their turn yield their heat to the incoming gases. This is the alternating system. The heat in a coal reverberatory furnace probably never exceeds 3,500° F.; that produced in a gas-furnace by direct combustion is the same, plus the heat returned by the regenerators, and may reach 4,500° F., which is the heat at which dissociation commences, and is therefore the maximum attainable by the combustion of the gases employed. 2. The other form of regenerator is, properly speaking, a stove, in which the outgoing gases pass on one side of thin conducting partitions, while the incoming gases flow along the opposite side, the heat being continuously transmitted through the partitions. This continuous system of regeneration, although employed in a limited or an imperfect manner long prior to Siemens's experiments, and considerably improved by Gorman in the English furnace bearing his name, has again fallen into disuse. The gas-producer has also been the subject of many modifications to suit different fuels. The one illustrated in longitudinal section by Fig. 10A, and in cross-section by Fig. 10B, is the form designed by Wellman for bituminous coal. It is a strongly bound fire-brick chamber, from 7 to 8 feet square in its largest dimensions and 7 to 10 feet deep. Coal charged through the gas-tight hopper A is slowly burned on the grate B. The fire is stirred by a bar inserted at the hole C. By means of the flue D the gas enters the flue E to the main underground flue M, which is also the outlet of other producers arranged in line with it. Thence the gas is conducted to the furnaces, which may adjoin the producers or be hundreds of feet away. Air for combustion was formerly drawn into the grate by means of the furnace chimney, but blast is now generally introduced under the grates in order to control the rate of combustion better. Some 2 tons of coal are burned in 24 hours in each producer. The anthracite producer is usually larger and has more grate surface, and jets of steam are employed, chiefly to soften the clinker. The use of water as a means of furnishing combustible gases has not proved advantageous, because their combustion produces no more heat than that abstracted in decomposing the water into these gases. Bituminous coal having been lighted in the producer, the volatile constituents, chiefly hydrocarbons and water, are first evolved. Of the remaining 60 or 70 per cent. of solid carbon, that next the grate is burned to carbonic acid, which, by rising through 2 or 3 feet thickness of incandescent carbon, is changed to carbonic oxide. The gases passing to the furnace consist chiefly of carbonic oxide, 25 per cent.; hydrocarbons, 10 per cent.; and nitrogen, 60 per cent. The producer and gas-flue should contain a slight excess of pressure over the atmosphere to prevent the inflow of air through crevices, and the consequent combustion and waste of gas. Placing the gas-producers below the furnace, or supplying them with air by a fan rather than by the furnace chimney draught, best accomplishes this purpose. The modifications of the Siemens producer, now generally preferred in American metallurgical practice, are those of S. T. Wellman, of Thurlow, Pa., and J. W. Taylor, of High Bridge, N. J.

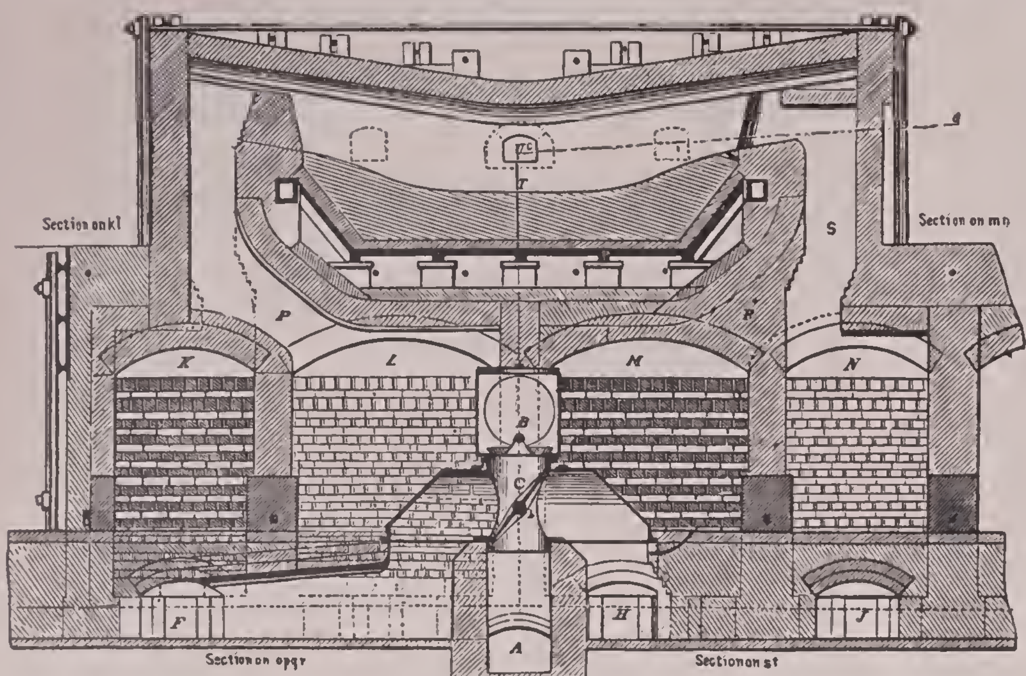


FIG. 11.—Siemens gas-furnace.

The Siemens Gas-furnace.—The general structure and details of this furnace, for both melting and heating, are illustrated by Figs. 11 to 14, which represent a 5-ton open-hearth furnace for the manufacture of Martin steel out of cast and wrought iron, as built by S. T. Wellman for the Otis Iron and Steel Company, Cleveland, O. Although the design is now antiquated, the drawings well serve the purpose of illustrating the principles of construction and operation. A furnace of modern design, in which natural gas is used as the fuel, is shown in the article STEEL. Above the floor-line W (Fig. 13) the furnace is a rectangular iron box about 22 by 10 feet in plan, strengthened with buckstaves, roofed and lined with fire-brick, and furnished with charging doors, U, like the ordinary reverberating furnace. The sand-bed or hearth, T, upon which the materials are melted rests in a heavy cast-iron basin, beneath which there is free circulation of air to preserve the parts from excessive heat. By means of the spout V the steel is conducted to the casting ladle. Fig. 14 is an exterior view of the charging side of the furnace and of the regenerator below. The regenerator consists of four fire-brick chambers, K L M N (Fig. 11; shown in horizontal section at Fig. 12, and in cross-section at Fig. 13), which are filled with a checkerwork of fire-bricks stacked loosely together, so as to present the largest amount of surface to any gas entering the chamber. From each of the end chambers, K N, two gas-ports, S, lead up into the furnace (as shown on the right of Fig. 11, and in plan on the right of Fig. 12). From each chamber, L N, three air-ports, P (Fig. 11) and R (Figs. 11 and 12), lead up alongside the gas-ports to a higher point in the furnace, in order to promote a more thorough mixture of air and gas.

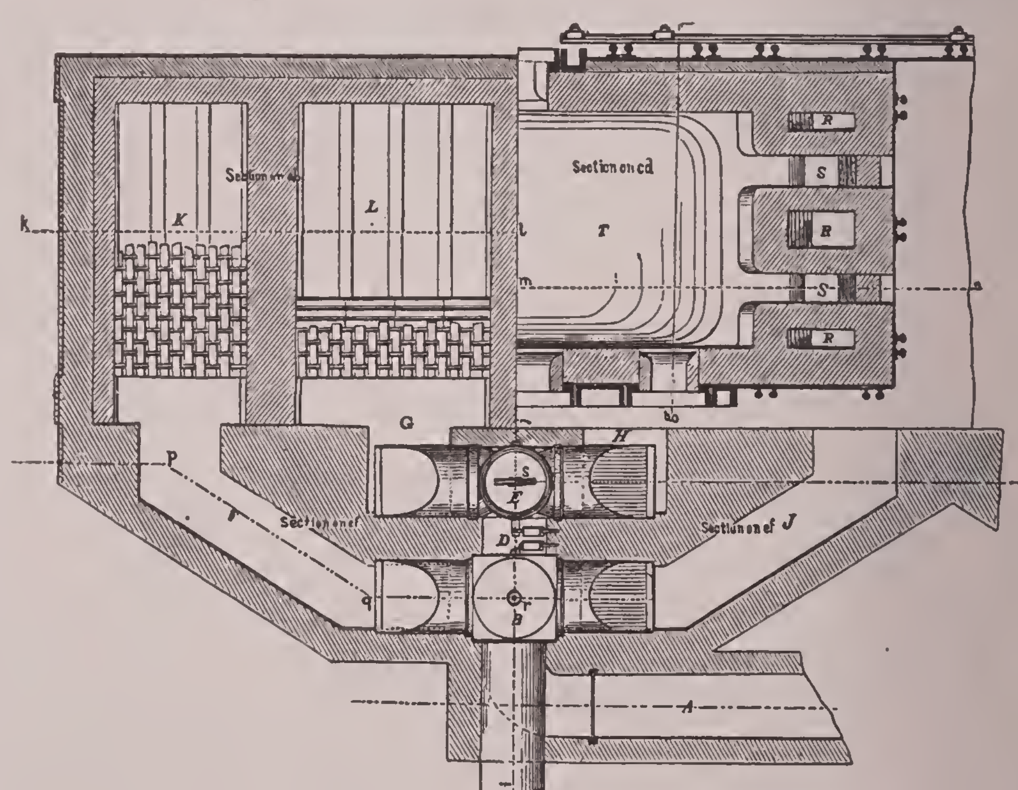


FIG. 12.—Siemens gas-furnace (horizontal section).

The ports thus form a sort of vast argand burner at each end of the furnace. The gas, air, and reversing valves and flues are shown in cross-section at Fig. 13, in plan (laid over a horizontal section of the flues) at Fig. 12, and in longitudinal section (laid over a longitudinal section of the regenerators) at Fig. 11. The operation is as follows: Gas from the producers, regulated by the puppet-valve B, passes down through the reversing valve, C (Fig. 11), which is so set as to throw it into the flue, F, and the regenerator, K, where it percolates through the mass of red to yellow hot brickwork, and thence passes at an equally high temperature into the furnace. Meanwhile air, regulated by the valve, E, is drawn by the furnace chimney into the reversing valve, C′ (Fig. 13), which, being set similarly to C, guides the air through the flue G into the regenerator, L, where it is also heated red hot, and in this condition it passes up the port, P, and meets the red-hot gas at the mouth of the furnace. The combustion is instantaneous, and intense enough, if the gas is not carefully regulated, to melt down the roof of the furnace. The flame is thrown down by the roof upon the bath of metal in the hearth, T; thence it passes down the ports, R S (Fig. 12) into the two regenerators, M N (Fig. 11), which absorb its heat; and thence it escapes through the flues, J H, under the two reversing valves, C C′, and into the chimney-flue, A A′. After twenty or thirty minutes, the two left-

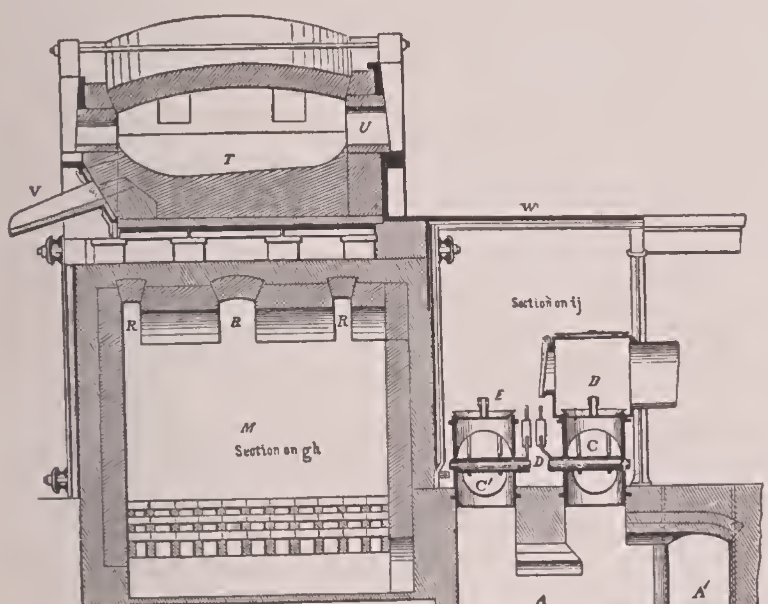


Fig. 13.—Siemens gas-furnace (cross-section).

hand regenerators having been somewhat cooled by the ingoing air and gas, and the two right-hand regenerators having been highly heated by the outgoing products of combustion, the valves, C C′, are reversed by means of the handles, D, when immediately the currents begin to move in the opposite direction; the gases pass into the furnace at R S and out through the regenerators, K L. The chief advantages of the gas furnace over the coal furnace are—1. Less than half the coal is required for a given heat; but since the escaping heat of the gas furnace is expended in regenerating gas rather than in raising steam, additional

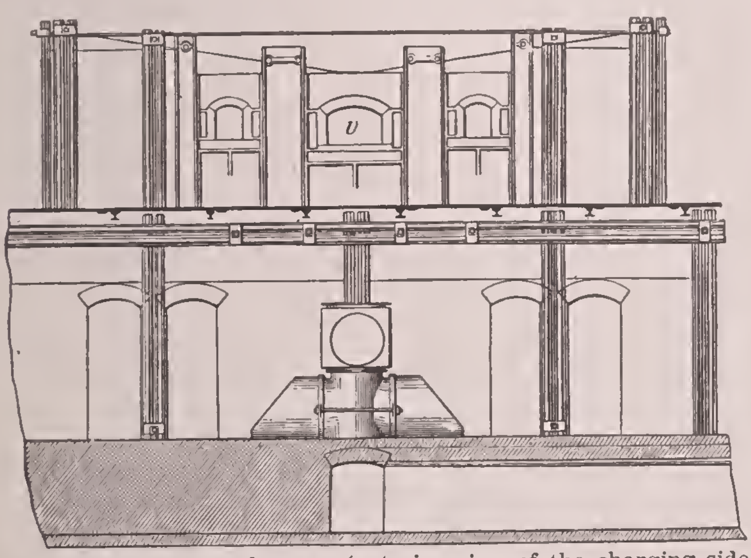


Fig. 14.—Siemens gas-furnace (exterior view of the charging side, and of the regenerator below).

coal must be burned under the boilers, so that the fuel-saving is reduced in rolling-mills to about 25 per cent. 2. The saving in the oxidation of the iron heated is about 3 per cent.—a greater economy than that in fuel—and is due to the complete command of the chemical character of the flame. The prevention of smoke, the saving of space and labor, and the cleanliness of works are also considerable advantages. It will be observed, by comparing the open hearth with the pot furnace and the puddling furnace hereinafter described, that the use of gas and of regeneration may be adapted to any required shape of furnace and to all varieties of work. In the glass manufacture, for example, they are largely employed. In the gas *heating* furnace the bed is usually made much larger than in the coal reverberatory (Fig. 3), because uniformity of temperature can be much better maintained. The largest practicable coal furnace will heat, for instance, 6 or 7 three-rail steel ingots weighing a ton each; a perfectly manageable gas-furnace, 20 by 12 feet on the bed, will hold 15 or 18 such ingots. The continuous regenerator will be described in a following paragraph.

The Pot Furnace.—This is a small furnace, worked at a very high temperature, for heating fire-clay or plumbago

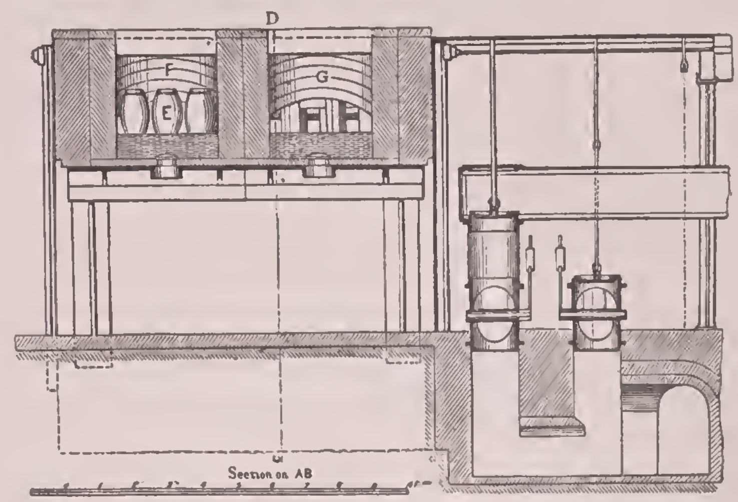


Fig. 15.—Siemens gas-pot furnace (longitudinal section).

crucibles or pots in which steel, brass, and other metals are melted. In the manufacture of crucible steel the pots containing the ingredients (chiefly wrought iron or cemented steel, and a little carbon and manganese) are about 15 inches high by 10 inches in diameter. From two to six of them are placed in a "melting-hole," which is a fire-brick furnace just large enough to hold them and the fire in which they are partially buried. The top of the furnace opens, by means of a lid, on the general floor of the building; a grate beneath communicates with a subterranean ash-pit and gangway. The fire in a coal furnace is urged by a powerful blast, and the escaping heat from a long row of melting-holes passes under a common steam-boiler. When the metal is ready to cast, the lid of the furnace is drawn to one side, the pot is lifted out, the cover of the pot is removed, and the metal is poured into a mold. Figs. 15 and 16 are respectively a longitudinal and cross-section of a Siemens gas-pot furnace. The general structure of a melting-hole and the situation of the pots E, whether coal or gas fuel is used, is shown at F G. The structure and operation of the regenerative apparatus will be understood by referring to the foregoing description of the open hearth. Gas and air, entering the hot regenerators I H respectively, mingle and burn as they enter the melting-hole G; thence they pass into and heat the regenerators J K. By means of the reversing valves the currents are changed from time

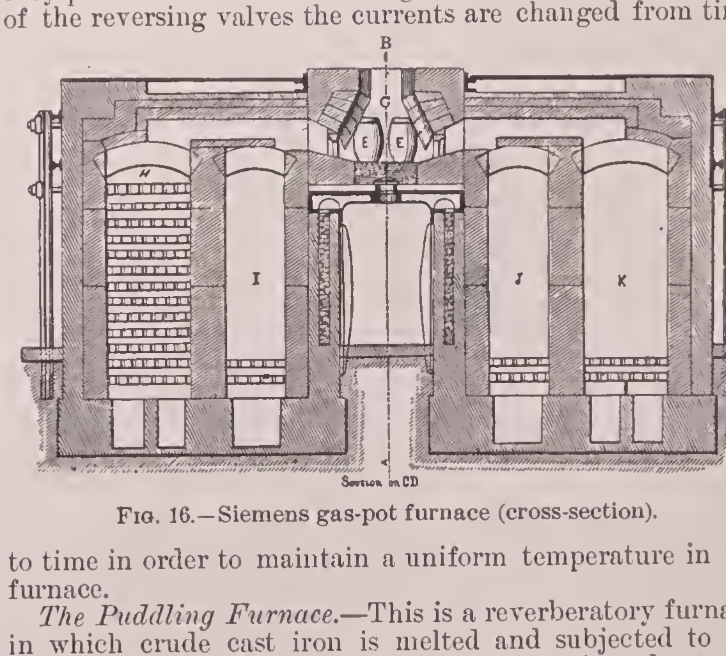


Fig. 16.—Siemens gas-pot furnace (cross-section).

to time in order to maintain a uniform temperature in the furnace.

The Puddling Furnace.—This is a reverberatory furnace, in which crude cast iron is melted and subjected to the oxidizing action of air and of oxide of iron, in order to remove its carbon and silicon, and thus convert it into a pasty mass of malleable iron. Its general construction is like that of the heating furnace (Fig. 3), except that its hearth is formed like that of the open-hearth furnace (Figs. 11 to 14). When gas fuel is employed the regenerative system is substantially that shown in the last-named engravings. The single puddling furnace has a door at one side of the hearth by which the iron is inserted and the "ball" is removed. Through a notch in the door the workman inserts the "rabble" or hooked iron bar by which he stirs the bath and forms the iron into balls. A double furnace has doors on both sides, through which two men work in the same bath. The product of a double furnace is about 2 tons in ten hours. Many attempts have been made to increase the product of the puddling furnace and to relieve the severe manual labor of stirring the charge by mechanical appliances, chiefly by means of the revolving furnace. These contrivances have all been abandoned.

The use of rotary furnaces is now confined in American metallurgical practice to the different modifications of the Brueckner cylinder, employed in the roasting (expulsion of sulphur) of copper ores. These rotary furnaces are simple large brick-lined iron shells, resting on rollers and driven by power, having at one end the fire-box in which the fuel is burned and at the other end the flue from which the gases of combustion and of roasting escape.

Conclusion.—A treatise on furnaces without descriptions of the different smelting furnaces, and of numerous standard forms of apparatus for applying heat in the various arts, is obviously incomplete. They are all, however, special applications, and as such are described in the treatises on these arts, and they are all modifications of the typical forms herein described. In those arts where fuel is used on the largest scale, such as the manufacture of wrought iron, steel, and glass, and where the highest temperatures are required, the grand improvement of the period, already becoming general, is the use of gaseous fuel, and its regeneration by means of the escaping heat of the furnace. One, at least, of the most important modern manufactures—that of open-hearth steel—is the direct result of the regenerative gas furnace. Heat of sufficient intensity and of suitable chemical character was unattainable by any other known means. The temperature of dissociation having been attained, further improvements would appear to lie in the direction—first, of economy—less than one-tenth of the theoretical value of fuel is utilized in the best furnaces; second, of more enduring refractory materials—fire-bricks are melted at easily attainable heats, and all refractory compounds are soon destroyed by chemical reaction with the ingredients under treatment.

Revised by C. Kirchhoff.

Furnes, fürn [from Flemish *Veurne*, Furnes]: town of Belgium; province of West Flanders; at the junction of three canals; 13 miles E. by N. of Dunkirk, France (see map of Holland and Belgium, ref. 9–A). It has manufactures of linen and leather, and a large trade in grain, butter, cheese, and linen. Noticeable among its public buildings are the Church of Walpurgis, erected in the ninth century, and the city-hall, erected in the thirteenth century. Pop. (1891) 5,465.

Fur'ness, Horace Howard, LL.D. (Harvard, 1894): Shakspearean scholar; b. in Philadelphia, Nov. 2, 1833; graduated at Harvard College 1854; studied law; was admitted to practice 1859; furnished chapters in Troubat and Haly's *Practice* on *Ejectment, Domestic*, and *Foreign Attachment*, etc.; has published eight volumes of a New Variorum ed. of Shakspeare's plays—viz., *Romeo and Juliet* (1871); *Macbeth* (1873); *Hamlet* (2 vols., 1877); *King Lear* (1880); *Othello* (1886); *The Merchant of Venice* (1888); *As You Like It* (1890); and *The Tempest* (1892).

Furness, William Henry, D.D., LL.D.: clergyman; b. in Boston, Mass., Apr. 20, 1802; a graduate of the Boston Latin School and of Harvard College 1820; studied theology at Cambridge, and was ordained pastor of the First Congregational Unitarian church in Philadelphia in 1825; resigned in 1875. D. Jan. 30, 1896. Dr. Furness was widely known as an author; he published a volume of prayers (1850), a volume of sermons (1855); wrote devotional poetry of tender feeling; made numerous translations from the German poets, and published a volume of prose tales from the German (1856). He printed many sermons in pamphlet, contributed articles to the *Christian Examiner*, mostly on his favorite subject, the New Testament Gospels, and was for three years editor of *The Diadem*, an annual published in Philadelphia. But his name will be chiefly remembered in connection with the anti-slavery movement, in which he took an intense interest, and on which he frequently and earnestly preached; and with the attempt to recover the character of Jesus by a fresh study of his biographers. His chief literary works are on this theme, the successive volumes being simply attempts at more complete and convincing statement. The first, *Remarks on the Four Gospels*, appeared in 1836; *Jesus and his Biographers*, in 1838; a *History of Jesus*, in 1850; *Thoughts on the Life and Character of Jesus of Nazareth*, in 1859; *The Veil Partly Lifted*, 1864; and *Jesus*, in 1871. These volumes he has followed up with many minor studies of the same general theme. He translated from the German, with notes and comments, Dr. Daniel Schenkel's *Characterbild Jesu*, an elaborate essay written as a reply to Renan's work (2 vols., Boston, 1866). For an estimate of his view of Jesus, see *The North American Review* for Oct., 1850. In 1886 he published *Verses and Translations from the German Poets*; in 1893, *Pastoral Offices*. Dr. Furness never took part in sectarian controversies, nor was he interested in the extension of the Unitarian faith as a peculiarity, preferring to stand outside of organizations.

Revised by J. W. Chadwick.

Furness, William Henry, Jr.: artist; b. in Philadelphia, Pa., May 21, 1828; d. in Cambridge, Mass., Mar. 4, 1867. On leaving school at the age of sixteen, he went into a counting-room, but was there only one year, his passion being for art. His skill in crayon portraits gained him reputation and money; he went to Brooklyn, N. Y., thence soon after to Boston, where a residence of two or three years enabled him to accumulate sufficient means by his pencil to spend more than two years abroad, studying art in Düsseldorf, Munich, Dresden, and Venice. On his return he established himself as a portrait-painter in Philadelphia, married, removed his studio to Boston, and lived in Cambridge. His improvement as an artist was rapid, and at the time of his death he stood in the front rank of his profession. His best work is marked by firmness of drawing, truth of color, fidelity to characteristic traits of feature, and fine feeling of expression. His genius was delicate, his spirit gentle, his taste refined; but earnest study saved him from weakness, and his simple love of truth imparted to his portraits a living charm. He was fortunate in his subjects. Charles Sumner, Lucretia Mott, Dr. Furness, John W. Field, Hamilton Wilde the painter, J. P. Lesley, the daughter of R. W. Emerson, with many persons besides of intellect and character, sat to him.

Furniture [from Fr. *fourniture*, furnishing, supplying, deriv. of *fournir*, furnish < O. Fr. *fornir*, from Teuton.; cf. O. H. Germ. *frummjan*, deriv. of *fruma*, use, advantage; cf. Mod. Germ. *fromm*, advantageous, useful, good, execute, do]: that with which anything is furnished; hence that which is needed to help anything discharge its functions, or to help any person do his or her work. Thus the locks and hinges in a house are a part of the furniture, as called for in the contract for building, and we speak of horse-furniture as including saddles and bridles and all their minor parts; so table-furniture includes all necessary and ornamental dishes and other vessels, knives and forks and spoons, table-cloths and other such accessories. But the word used absolutely means, generally, the tables and chairs, bedsteads and chests of drawers, which are used in a dwelling-house, the writing-desks, book-cases, etc., of a library or office, or in a fuller sense the above together with the bed-linen, carpets, curtains, and the like. It is not customary to include in *furniture* the pictures on the walls or the vases on the mantel-shelves, nor other articles of art and ornament having no utility.

Something of convenient height to sit on has always been found necessary for comfortable life, except among the Japanese of the so-called feudal period which ended in 1868, who were wholly independent of such convenience. A frame upon which to lay the cushions, rugs, or mattresses, which constitute the bed has also been found necessary, probably because it raises the sleeper out of the draughts of air which sweep along the floor, and out of reach of many insects and creeping things. Here again the Japanese have been an exception, needing no bedstead at all. Persons seated on chairs or reclining on beds or couches need tables upon which to lay small objects in use, and especially the dishes and other table-furniture at meal-time; and the Japanese, seated on their floor-mats, also require tables, though very low ones. Finally, shelves of some sort are needed upon which to lay, out of the way of harm, objects not immediately in use; and drawers, which are merely a modification of boxes resting on shelves, are an equally obvious device; the union of such shelves with drawers, or inclosed boxes of any sort, makes up the cupboard, sideboard, cabinet, chest of drawers, or wardrobe. Necessary furniture consists of these few types, the seat, the couch, the table, the cupboard. The Egyptians, at the time of their early wall-paintings, many centuries before the Christian era, had chairs of wood, with cane seats woven very much as modern ones are woven; others with seats of interwoven leather strips, and others with cushions; and also large and easy armchairs, with cushioned seats, arms, and backs. Wooden frames of some of these have been found in tombs in perfect preservation. Wooden bedsteads and "day-beds," or couches, they had also, and some of these were splendidly decorated. There was a very general custom of ornamenting these beds and couches with the heads, legs, and tails of lions, oxen, and other beasts, and this was carried so far sometimes that the whole piece of furniture appeared to be modeled after the creature chosen as its subject. A religious or traditional feeling had to do with this custom, no doubt. The larger armchairs, or thrones, as they may well be called, are represented as even more elaborately carved with heads and hoofs and paws of animals. Some of these were certainly made of metal, the wall-paintings make that clear; they were probably of bronze, and gilded. The discovery of one superb throne in excellent preservation, now in England, has proved that sixteen hundred years B. C. the Egyptians knew how to combine hard and fine grained wood, richly carved, with solid silver and gold and the same metals in thin plates, into one rich and really noble design. The Egyptians were great masters of metal work, and their gold and silver plate must have been splendid, to judge from the wall-paintings and to reason from the analogy of the jewelry found in mummy-cases; the plate itself has perished, except in a few cases, its intrinsic value insuring its reduction to ingots or coin at any change in the political world; the few pieces which have been found in the tombs are of spirited design, but a very great number of large and very minute representations of vases, cups, dishes, etc., has been collected by M. Prisse d'Avennes from the wall-paintings, and their variety, richness, and beauty are astonishing. (See METAL-WORK.) Spoons, ladles, and dishes of hard wood are found most richly carved in the semblance of human figures, as slaves carrying burdens, children, lute-players, females in the attitude of swimming and supporting the bowl of the spoon between their hands, as if they were trying to keep it afloat and before them. Some of these are painted in elaborate variety of color, others are left of the natural tint of the wood, and inlaid with glass, other woods, ivory, etc. Toilet articles also of painted wood exist in the collections, some of them worked into fanciful bouquets, the large flowers of which unscrew, revealing small boxes and trays. Egyptian physical civilization seems to have been as carefully organized for comfort and display as that of modern Europe, and this civilization the people of the Nile knew how to maintain for a space of time which dwarfs by comparison all the epochs of Europe.

Fig. 1.—Throne or armchair, from an ancient Egyptian wall-painting.

The Assyrians are shown in their bas-reliefs seated on couches and thrones, with bedside tables and stools, vases and dishes of varied form. The tables are lower than the couches, as would be more convenient. We know that the ancient Persians and the peoples of Asia Minor had rich and splendid furniture. The people of India have been makers of splendid articles of mingled use and beauty from time immemorial. The great empire of China will give the archæologists, whenever they may choose to improve it, the best chance they are ever likely to have of studying the history of decoration and furniture, combined with custom, tradition, and strong family and ancestral feeling, prolonged through untold centuries. From Greek and Roman antiquity, strangely enough, there is little to be learned. We know something of the furniture of display and convention, the marble tables and lamp-stands, and we know the bronze articles of utility which Pompeii has preserved for modern times, but little else has been learned with any certainty. We know that small tables were brought to the distinguished guests in Homeric times, one for each guest. We find that the custom of removing the tables with all on them and bringing others, was a later Greek practice as well. So, too, in the Roman *triclinia* or dining-rooms we read of how the whole table was removable at one time, and how, at a later time, the leg or upright of the table was made permanent, and only the top movable, and intended to be changed with the changing services; and we read of the "fad" there was for the use of splendid veined and knotted wood for these table-tops, and of the enormous prices paid for some of them. So we learn from allusions in contemporary writers that table-cloths came in with the Emperor Tiberius. But what the tables looked like and how they were built we can hardly guess, except from one or two paintings in Pompeii—hasty scrawls of feeble execution. What tables either Greeks or Romans used in the work-rooms, the open air sitting-rooms, or for writing, we do not know. About their couches and chairs we are a little better informed. Elaborate frames of bronze of both chairs and couches have been found at Pompeii, and wooden frames of the dining-room beds, richly adorned with bronze ornaments. We learn from allusions in Roman books and from vase-paintings, mosaics, coins, and bas-reliefs, that chairs were of different materials, some even of wicker-work, though probably not of rattan; we learn that there were chairs with backs and arms, and those without either; chairs with four straight legs and those with crossing supports like camp-stools, sometimes really folding up at pleasure, and sometimes having that form only, a traditional form of some importance, for of these were the famous curule chairs of the Roman magistrates. As for the stately armchairs with high backs, thrones in the proper sense (see THRONE), we find more of them in Greek art than in Roman art and narrative combined; for the vase-paintings present a great number of them and a variety of types. It is very doubtful, however, whether these were often used in the household, even in that of a prince; they are essentially articles of ceremony, and especially of the ceremony of worship.

Pompeii has kept safe for us a great number of bronze articles now in the Naples Museum of a kind unfamiliar to modern life. Thus the lamp-stands (candelabra) are of many sorts. One kind is composed of a straight, upright slender column, supported by a three-footed stand, and carrying a spreading top; the whole as delicate and light as practicable, the decoration partly in mere fluting and beading, partly in the animal and half-human forms used at the top and in the stand. These were to carry only one lamp each. Sometimes the slender upright was adjustable in height, a rod sliding in a sheath, and held at any point by a pin fitting in a hole. Other candelabra are two-branched or three-branched, and these have often a spirited figure as of a satyr or sphinx serving as the main stem, or affixed to it. Others again are made to hang several lamps from by chains, and still another sort is for the table, the stand being not more than 6 inches high, like the carved wood *socle* of a Chinese vase. The lamps themselves also were often beautifully worked in bronze; and there is something strangely foreign to our modern ideas in the combination of costly and very artistic appliances for the production of a light as feeble and uncertain as that of olive oil with a wick floating in it. Other curious bronzes are the little portable kitchens in which, on a stand a foot square, or but little larger, a fire-hearth, a boiler for water, and other apparatus for simple cooking are brought together. The utility of these is incontestable; like the modern chafing-dish, they allow of a great deal of delicate and skillful preparation of simple food.

The impression made upon the student of the existing monuments is that the Greeks certainly, and the Romans probably, asked for much less elaborate and less carefully adjusted furniture than the moderns require. They adapted their needs to the simple although often rich and stately table of stone or marble, seat of bronze or massive wood, bookcase or cupboard recessed in the wall. They wrote, as modern women write, on the knees, while the table beside them held their scrolls and inkstand. They kept their books in covered boxes, labeled on the outside. The presence in all well-to-do households of many slaves, often of quick-witted race and of some education, made elaborateness of furnishing and all labor-saving devices less necessary. And their life was more generally that of the agora and the forum, of out-of-door intercourse, business and politics, than we can well imagine.

Our knowledge of the furniture of the Middle Ages is derived from allusions in literature, from representations or suggestions in architectural and decorative sculpture, from paintings in manuscript books, from tapestries, and from the objects themselves which remain to us. It is obvious that from all these sources alike the amount of our information is very slight for the most ancient period, and grows rapidly more abundant as we pass the twelfth century and approach modern times. What Charlemagne had about his private rooms, or what his nobles or their retainers, or the townspeople, or the rustics of his time owned and used, we can only guess by inference from later times. Of the epoch two centuries later we can gather some few facts, but only a few. Fortunately it is not very misleading to reason backward from a time we know more about. Thus that the walls were very rarely covered with hangings of any sort in Europe, before the fourteenth century, follows from the low state of the textile industry of the time, and is also known from the miniatures which show us walls rudely marked off with lines and simple patterns in two or three colors, probably done with water color on the stone. So it is easy to see that the seats of the ninth or of the eleventh century would not differ widely from those of the thirteenth; that they would naturally be first, and chiefly, the chests which were ranged along the walls, and which contained clothing, table-linen, bed-linen, and, on occasion and in rare cases, pieces of rich stuff brought from the East and serving for decoration; secondly, the state chair which each high-placed family kept for its head and representative on frequently recurring days of ceremony; thirdly, benches and stools, large and small, a survival of which one finds to-day about the choirs and sacristies of Italian churches. About the bedsteads we know less; that is to say, very little. Concerning cabinets and cupboards we need only reason that they were very few, even fewer than the bedsteads probably were, for there was little to keep in high *armoires* and *bahuts*, which low and simple chests, useful also to sit on and to sleep on, would not hold as well, while skillful woodworkers were not numerous. There were no books. There were no pieces of decorative art. There was no fine china and no glassware at all. And as for mere adornment of the apartment, the nobles thought little of indoor life, and had but one private room to serve for sleeping, and for such affairs of society, eating or business, as were not to be carried on in the great hall amid vassals and followers, while all below the highest ranks would find such pieces of furniture wholly unattainable.

These remarks apply to the whole epoch from the disappearance of the last remains in Western Europe of the customs of the Romanized provincial nobility to the time when our sources of information became more frequent and more trustworthy. It is a tendency of recent archæological writing to claim a more advanced state of physical civilization for the early Middle Ages, on the strength of special discoveries of documents and monuments of the time, but these point only to exceptional and very rare instances of lingering tradition, or of enlarged ideas brought from over seas. The Byzantine empire was the center of art and of material civilization until the ill-omened second crusade, and undoubtedly a traveler brought home ideas of comfort and articles of luxury now and again from the great capital of the East. In the south of Italy and in Sicily something of Græco-Roman suavity of manners and ease of life had been retained, even to the iron time of the tenth and eleventh centuries. But generally the world of Europe of those days can best be judged, so far as its physical state of well-being goes, by means of a study of the peasants' houses in out-of-the-way parts of France or South Germany, or perhaps, as indeed travelers tell us, in Bulgaria and Servia, and in like regions of traditional and slowly changing customs. The bedstead is built permanently into the structure of the house, and forms part of it; it is rather pretty, with its paneling in hard wood and its bit of carving here and there; there is only one such, and that is in the living-room, for the younger members of the family sleep no matter where, in the garret on some sacks, or in the hay-loft, or rolled up in a blanket in front of the living-room fire. The coffers or chests are handsomely worked and tastefully though slightly decorated with carving, or a bit of inlay in wood, and even ivory, or shell on the sea-board; and they have each a splendid wrought-iron lock with a powerful bolt and a key as heavy as a horse-pistol, and quite beautiful in its *naïf* and barbaric ornament, but there are not more than one, or at most two, of them in one house. The table is massive but not very showy. Besides the chests there are no seats but stools, either three-legged, made by fixing round bars into a piece of plank, or made with two plank uprights, each cut out at bottom to form two feet with a graceful enough sweep between them, and two shorter and thinner pieces nailed across between the uprights to stiffen the whole. The chimney gleams with bright copper vessels which are the mistress's pride and joy, and which are of all dates from five centuries ago to yesterday. All this would be found much in the same condition in the house of a well-to-do family of the Middle Ages, if we could visit one to-day, and with it would be found a display of coats-of-mail, head-pieces and serviceable weapons, hung upon the wall. The noble family would have, in addition, the chimney-piece adorned with the armorial bearings of its chief, and the chair of state in the lord's chamber, which chamber itself would be more of a separate and a dignified apartment than any piece except the living-room in the modern house we have been considering. See House.

With the fourteenth century there came a very marked increase in the standard of comfort, both among the nobles and among the more well-to-do townspeople. The nobles sought in their castles something of the space and convenience of a country residence, combined with the defensible fortress which they could not yet spare. The townsmen built much larger houses than before, with separate rooms for the several needs of life, and with a good deal of care taken to provide large windows, pleasant places to sit by the window and by the fireside, and out-of-door *loggias* and porches.

With all this came a great increase in the number, and also in the richness, of the pieces of furniture employed. But the variety was not largely increased; the bedstead, the table, the chest, and the unbacked stool or bench, still made up the greater part of any man's furniture. Cushions were more numerous, as we may suppose; at least they were not few in the fourteenth century, for the miniatures show them in use in chairs, on benches, on chests—soft ones like pillows, firm and square-shaped ones like those of our old-fashioned wooden-seated armchairs. Hangings, door-curtains, window-curtains, table-cloths are common in the richer houses, and are not unknown in the others, at least of the towns. And in one respect the pieces of furniture of wood were different from those of the twelfth century and before, namely, in the much freer use of sculpture in their adornment. The earlier pieces had been decorated with inlaying, more or less, but especially with color applied by the paint-brush; they were massive and rather grotesquely ponderous, with huge square sticks and thick planks for their framework, and color for their chief adornment. But with the fourteenth century came the influence upon all woodwork and all minor ornamentation of the wonderful system of Gothic architectural sculpture. The end of every arm of a chair or bench was carved into a dog or a strange, semi-heraldic lion or a dragon, or at least a dragon's head; the wood of it, wherever unnecessarily thick was cut away for lightness, but a little of this was left behind in a delicate and rich group of leafage and small animal forms, helping by the general mass of the sculpture the main lines of the piece; even the chests received their share, though a less liberal one, but the bedstead and the chair of state received the richest sculpture, while the *settle* of the fireside, the state chair's domestic and popular enlargement, now growing common, had a share. The carving in oak of Northwestern Europe, and especially of France, from 1350 to 1400 is marvelous in beauty. But little of it remains, but enough to show it to be the early maturity of that splendid art which reached its culmination in the stalls of Amiens cathedral of about 1510, which kept its place, though with diminished importance, through the three following centuries, undestroyed even by the pomposities of the Louis XIV. period, and which lingers on even at the close of the nineteenth century in the traditions of the workshops in the towns of France. Besides the settle, the *cupboard* or *dresser* makes its appearance in the fourteenth century—a combination of shelves upon which to show off pieces of plate, with perhaps a locker or shut-up place beneath, and worked into a showy piece of furniture. Perhaps the distinction should be made between the cupboard or dresser which was of great stateliness, with even some limit as to the number of its shelves for each rank of life, and the simpler *crédence*. But either was as handsome as the owner's means admitted, and either was an almost immovable piece of furniture, a wall-piece, like a modern bookcase. It is noticeable, indeed, how all the furniture of decorative character tends to be fixed and immovable in character throughout the Middle Ages. The seats are throne-like chairs with footstools, high backs, and even canopies; the settles are high and heavy, and often raised, with a permanent platform-like footstool in front, inclosed at both ends, veritable islands in the stone-paved halls. The tables are sometimes less permanent, for the lord and his guest sat under their canopy on their raised seat, while a table was brought by the servant and set before them; but these tables were plain, hidden by cloths and draperies when served; and the decorative table was apt to be a ponderous thing, sometimes combined with shelves or cupboards below, for the two or three books of the scholar's library, sometimes having a revolving reading-desk above. In fact, the chief pieces of furniture were heavy and bulky things throughout the Middle Ages, like our grand pianos and bookcases, modifying in a serious fashion the rooms they were put in, unless those rooms were the huge and lofty halls of general resort. Light and dainty furniture is of a much later time.

With the fifteenth century, and the time of Louis XI. and his rival Charles the Rash and the English wars of the Roses, came the Renaissance in the North. This was not,

Fig. 2.—Crédence, late fifteenth century.

at first, in architecture and in furniture, a matter of classical gravity and simplicity of line—rather was the Gothic style more ornate and its decoration more florid before its final disappearance; but the forms were more light, the sculpture more delicate, the ironwork hammered and chased as finely as bronze; the pieces of furniture more numerous, more varied, and serving more numerous and varied requirements. Most of all, painting had almost disappeared from furniture. The richer the carving the less elaborate the painting of course; that had long been the rule; but now the use of painting had almost wholly disappeared from elegant furniture. The cabinet of two bodies now becomes common; not the mediæval *armoire* with one pair of doors from top to bottom; not the *crédence* in any form, but the decorative piece composed of a large lower chest and a smaller upper one. This *double press* or *bahut à deux corps* was not wholly novel in the sixteenth century, but the earliest specimens that remain to us are of that time, and the form seems to have been rare previously. It allowed of great novelty of design, for the natural and obvious treatment of it was much more architectural than would have befitted the old wardrobe or the dresser. At first the two parts were mas-

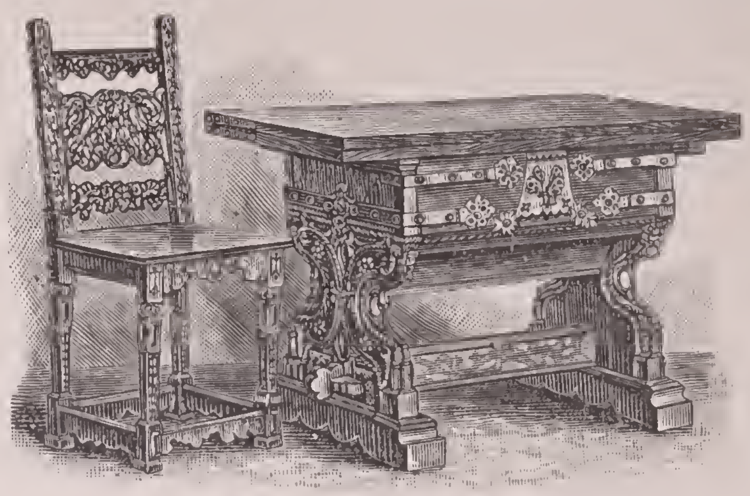


Fig. 3.—Table with locker which is opened by revolving the top; the top itself is in two folds; wrought-iron straps and lock plate; seventeenth century. Chair, same period.

sive oaken boxes simply adorned with shallow carving and with richly wrought-iron hinges and fastenings; but soon the introduction of the classical pilaster and entablature into architecture suggested the uncalled-for and wholly inappropriate ornamentation of wooden furniture by means of the same architectural members.

For the two centuries beginning with the year 1500 the furniture is like that of the Middle Ages, in being massive, of plain solid wood, without upholstery in our modern sense except in rare cases, consisting mainly of the old fixed or "standing" bedstead, the huge and heavy wardrobe or cabinet, the massive settle, bench, or form, and lighter pieces much more simple in design. But it was very unlike the Gothic furniture in its details, and less reasonable, less natural; tending to strange bosses and vase-shaped enlargements in the table-legs and bed-posts, and as whimsical as possible in its carving when made anywhere away from the great centers of art. Still it has great character, almost all of it. Houses have many more rooms requiring to be furnished than of old, and therefore small tables, small chairs with backs, presses and cupboards of more moderate dimensions than when one only was needed for a household, become common. The great change appears with the introduction of upholstered furniture. Generally, throughout the Middle Ages as in antiquity, the cushion was laid upon the seat or set up against the back of the chair or settle, and if any piece of stuff was nailed fast to the wooden frame it was commonly a mere decorative piece of splendid material hung over the back. But there is record of stuffing as well as of covering with a textile fabric or leather as early as the four-

Fig. 4.—Chair made of planks carved and pierced, sixteenth century.

teenth century. It may also be inferred that when a piece of velvet was nailed fast to the back with gilt-headed nails, the doing of the same to the seat as well, and the stuffing with wool beneath each of the pieces of velvet, would follow. Still there was not much upholstered furniture before the beginning of the seventeenth century. Then all at once, in the times of Louis XIII. of France, James I. of England, and their contemporaries, the seats of armchairs and of chairs appear as covered with leather or brocade, sufficiently stuffed and ornamented with rows of nails and fringes. The backs of these pieces of furniture are more commonly covered with a single thickness of the material, and not stuffed at all. The evidence for all this is mainly in the pictures of indoor life, far more numerous in the seventeenth century than before, but the wooden frames of many chairs of the time exist, and the seats are often made with a recess for the stuffing, the sides rising above the flat part of the seat, while nail-holes show all along the edges. Some few pieces exist, also, in what appears to be their original state. Later, and under Louis XIV., the seats made for elegant rooms put on the air familiar to us in the nineteenth century; the seats, backs, and arms are all stuffed and covered alike; pieces of tapestry or silk damask are woven for the purpose, and fit the wooden frames accurately; the forms of the wooden frame, previously square and firm, become yielding and as it were pliant in the curves they affect; the sofa takes the place of the settle; pieces of furniture are made in sets, the two sofas, two armchairs, and four or six chairs being covered with the same pattern of tapestry, as well as alike in the woodwork. This movement is of course contemporary with a very great advance in luxury and comfort, and even the simpler homes of the citizens had their varied seats of handsome fashions made in sets to match. Strange modifications of chair and sofa came into being, some of which the nineteenth century seems to have lost, to its disadvantage; there was the *chaise-longue*, originally a sofa without back but with a high arm at each end; or, as it might also be called, a union of two chairs by their front

Fig. 5.—Armchair or fauteuil, eighteenth century, reign of Louis XV.

edges, the two backs rising at the outer or opposite edges. There was a modification of that, by which one larger chair, or armchair, could be combined in a moment with a smaller one and an ottoman, the ottoman coming in the middle, and the three pieces of furniture forming a very luxurious sofa to lie upon. There was the sofa with settees, in which a long and large sofa had its two ends cut off, and separated from the rest by "arms," these two end-pieces being very often rounded away toward the back, so that each became a quarter-circle corner seat. In all these an extraordinary amount of fancy was employed, and great power of graceful design within certain very well marked limits. Indeed, all the decorative design of the years from 1675 to 1725, especially in France, however it might lack in dignity, was full of appropriateness and a kind of refined luxury. The snuff-boxes, watches, *étuis*, etc., of the time are marvels of delicate fancy. The bad tendency of the time, as to decoration, was toward excessive curvature in scrolls and borderings, and toward a treatment of the solid parts of house-fittings and furniture as if they were metal instead of wood. Indeed, they were made of metal, more or less. Quantities of furniture were made of silver for the service of Louis XIV., all or most of which was sent to the melting-pot during the national misfortunes of the closing years of his reign. Silver tables and frames for chairs exist in the United Kingdom, most of them dating from this epoch. Drawings and prints of furniture of the time exist, as to which it is impossible to be certain whether a metal or a wooden piece is intended.

A reaction came during the reign of Louis XVI., when there was a return toward more natural forms. Straight legs and straight horizontal pieces became the fashion. These wholesome changes were accompanied by extreme lightness of parts. The workmanship of the time was exquisite, and there was a very full use of small *plaques* of

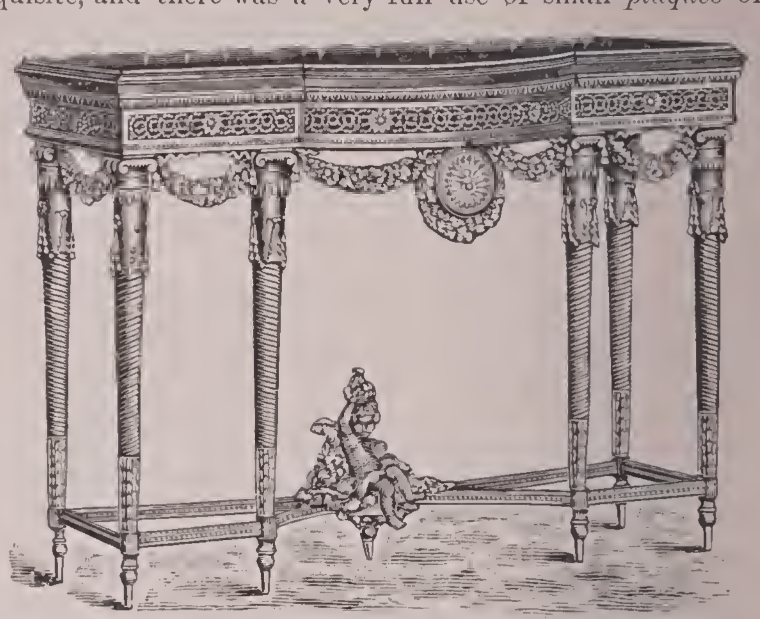


Fig. 6.—Wall-table or gueridon, late eighteenth century, reign of Louis XV. of France.

porcelain, delicate corner-pieces and mountings of gilded bronze, and similar accessories; moreover, the use of colored veneers and inlays of metal, shell, and similar material made great progress during the years from 1675 to the Revolution. (See Marquetry.) So that the most dainty and charming furniture known to us is undoubtedly that of France and of the years 1750–80.

The furniture of the nineteenth century lacks character, as does decorative art of other kinds. Since 1850 there has been a very marked increase in the splendor and cost of interior fittings and furniture, not only in the private houses of the very wealthy, but in hotels, public offices, business offices, and the dwellings of the people of moderate means; and with this has come a certain limited supply of rather spirited designing. In the great cities of Europe and the U. S. fashionable cabinet-makers turn out furniture very perfect in make and finish, and sometimes good in design There is a marked difference between the aim of the designers in different countries. In France it would seem the fixed purpose of nearly all the designers of furniture to adhere closely to some one of the accepted styles of not ancient dates, as Renaissance, by which is meant either the style of Francis I or that of Henry II., accordingly as it is early or late Renaissance, Henry IV. (for the intermediate reigns with their religious wars and confusion hardly count), Louis XIII., Louis XIV., Regency, Louis XV., Louis XVI. or Empire. In one or the other of these styles the draughtsmen are taught to compose and the workmen to execute. The result is exquisite in completeness, finish, tranquillity, the finest pieces seem as near perfection as one can hope to obtain; the old processes are revived, the old manners of work imitated, and an artist of one of the periods named might think his great efforts surpassed by his modern copyists. But they are copyists; and there is but little attempt to do anything, no matter how trivial, that was not done a century or more ago. On the other hand, the English makers are continually in search of novelties of form and composition. The most artistic designers have been trying ever since 1850, at least, to work out each design according to the purpose and make of the piece; this had its origin, perhaps, in the Gothic revival which affected all the decorative art of Great Britain, but it has been accepted as a general principle of composition. When the Parisian composes a cabinet in perfect Louis XIII. style, the whole forming a structure which might be of bronze or of stone for all it shows of the construction, the Londoner works his piece into true constructional truthfulness of design, every bit of wood telling the story of its insertion into the framework, and its utility there. The French work is immeasurably more graceful and more dignified, and it is adorned with exquisite carving. The British, far inferior in these respects, is designed on the right principle, and may, under more favorable conditions, develop into a real style of decorative work. Fine furniture in the U. S. partakes of both of these qualities and is evidently influenced by many contradictory suggestions from Europe.

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Furnivall, FREDERICK JAMES, M. A., Ph. D.: philologist; b. at Egham, Surrey, England, Feb. 4, 1825; studied at University College, London, and Trinity Hall, Cambridge, where he received the degree of B. A. in 1846 and that of M. A. in 1849. A lawyer by profession, he taught for ten years in the Workingmen's College, of which he was a founder. Later he devoted himself with enthusiasm to the study of philology, and organized numerous societies for the publication of English texts. Since 1854 he has been honorary secretary of the Philological Society, and on his sixtieth birthday he received the honorary degree of Ph. D. from the University of Berlin. He has published some thirty editions of classical English texts, the best known of which is his admirable edition of the *Canterbury Tales*.

Furruckabad: same as FARRAKHABAD (*q. v.*).

Fursch-Madi, EMMA: See the Appendix.

Fur Seal: a name given in common to those species of the family *Otariidæ*, or eared seals, which possess an abundant and dense undercoat of fine fur. Several species, representing two genera, belong to this group, and are all, to a greater or less extent, the objects of eager search. The species of the Alaskan seas is the *Callorhinus ursinus*; the southern species have not been identified with complete certainty, but three species at least are generally recognized—viz., *Arctocephalus falklandicus*, *A. cinereus*, and *A. antarcticus*. See OTARIIDÆ.

Fürst, JULIUS: Jewish scholar; b. at Zerkowo, Prussian Poland, May 12, 1805, where his father, a learned Israelite, was reader of the synagogue; was intended for the rabbinate, and when only twelve years old he was already versed in the Old Testament Scriptures, Jewish tradition, and Hebrew literature. He first learned the German language at the age of thirteen, and three years later he stood at the gates of a gymnasium in Berlin asking for admission to the *secunda* (or second highest class), and in 1825 was ready for the university. For a while he studied at the high school of that place, but, induced by the probability of securing a very prominent position among the people of his native province, he took up the study of Jewish theology at Posen. During his stay there he became alienated from Jewish orthodoxy, and in 1829 finally determined to give up the theological field. He went to Breslau to pursue Oriental and antiquarian studies, and in 1831 to Halle. In 1833 he went to Leipzig to become a journalist, few positions of literary eminence being then open to Jews. But his learning secured him an appointment as lecturer at the university, in which school he labored with great distinction. In 1864 he was made a professor, and enjoyed the same advantages as his Christian colleagues possessed. D. in Leipzig, Feb. 9, 1873. His historical, critical, and lexicographical works are numerous, and yet everything he wrote found favor, and all his publications are widely circulated. Particular mention deserve his *Concordantiæ librorum Sacrorum veteris Testamenti Hebraicæ et Chaldaicæ* (Leipzig, 1837–40); *Bibliotheca Judaica* (1849–63, 3 parts 8vo); *Hebräisches und Chaldäisches Handwörterbuch* (1851–61, 2 vols., 3d ed. by v. Ryssel, 1876; Eng. trans. by Samuel Davidson, 1865–66; 4th ed. 1871); *Geschichte des Karäerthums* (1862–65, 2 vols. 8vo). He also edited *Der Orient* 1840–51. S. M. JACKSON.

Furst, WILLIAM: See the Appendix.

Fürth, fürt: town of Bavaria (since 1806); at the junction of the Rednitz and the Pegnitz (see map of German Empire, ref. 6–E). It is a flourishing manufacturing town; its mirrors and articles of brass, bronze, horn, and bone are celebrated. The first railway in Germany ran from Fürth to Nuremberg, a distance of 5 miles. The town has twice been burned—in 1634 and in 1680. Pop. (1895) 46,592.

Furze, or **Gorse** [*furze* is from M. Eng. *firs*, *fyrs* < O. Eng. *fyrs*, furze; *gorse* is from M. Eng. *gorst* < O. Eng. *gorst*, perh. for **grost*, deriv. of *growan*, grow]: the *Ulex europæus*, an interesting Old World shrub of the family *Leguminosæ*, having numerous solitary golden-yellow flowers of much beauty. It has several varieties, some of which are cultivated in gardens. Furze is grown as a cover to foxes and as sheep-pasture. In Belgium the waste sandy lands yield large crops of furze, which is gathered when green, cut fine in a mill, and fed out to live-stock as a forage-plant.

Furzechat: See WHINCHAT.

Fusan, or **Pusan** [Chinese, literally, kettle mountain]: one of the three open ports of Korea: on the southeastern coast of the peninsula, and about 10 miles from the Naktong river (see map of China, ref. 4–M). It is locally called Kan (the post), the Japanese having maintained a military station there almost continuously since 1592. In 1876, on conclusion of a treaty between Korea and Japan, a settlement was made by the Japanese, who now control the trade of the port, which was opened to general foreign trade Nov. 26, 1883. Kan is neatly built, in the Japanese style, and contains, besides the consulate and the warehouses of the trading companies, a chamber of commerce, a bank, and a hospital. The harbor is landlocked, large, and deep. Vessels entered (1892), 735; cleared, 754. The principal imports are goods of British manufacture, Japanese wares, and salt; the principal exports are rice, beans, and hides. Total value of imports (1892), $1,388,130 (Mexican); of exports, $1,738,-323. Steamers ply regularly between the port and Gensan, Chemulpo, Vladivostok, Shanghai, and Nagasaki, and there is telegraphic communication with Seoul, the capital, and with Japan. Pop. (1891) 5,329, including 176 foreigners not Japanese. About 3 miles from Kan, on the north side of the harbor, is Fusan proper, consisting of an old and a new city, the former walled. Both are poorly built. A hill back of the city, bearing a fancied resemblance to an inverted kettle, gives Fusan its name.

Fusang: a country said to have been visited in the fifth century by a Buddhist monk named HWEI-SHIN (*q. v.*), and so called from a tree, supposed to have been the Mexican aloe, found growing there. Fusang has been identified by Charles G. Leland and others with Mexico or some part of the North American continent bordering on the Pacific, and by Klaproth and many others with Japan. R. L.

Fuse: See FUZE.

Fusee′ [from O. Fr. *fusee*, a thread > Fr. *fusée*, spindleful < Low Lat. *fusata*, spindleful of yarn, deriv. of *fusa're*, use the spindle, deriv. of Lat. *fusus*, spindle]: in the machinery of watches and chronometers, a cone spirally grooved, connected with a chain which may be wound upon the grooved cone. One end of this chain is attached to the base of the fusee, the other to the barrel or box containing the mainspring. The barrel, when the watch is wound up, rotates, being moved by the uncoiling of the mainspring. As the spring uncoils it loses its elastic force, but as a compensation the chain acts upon a longer lever, since, as the fusee rotates, the *point d'appui* of the chain continually approaches the base of the fusee. In this manner the uniform rate of driving force is maintained.

Fu'seli, Henry, or **Fuessli**, Heinrich: historical painter; b. in Zurich, Switzerland, Feb. 7, 1741; son of Johann Caspar Fuessli, portrait-painter (1707–81). After graduating at the University of Zurich in 1761 he entered the Church. He left the ministry, however, after two years, and, visiting England 1765–67, began the study of painting. Studied in Italy 1770–79, and returning to London attracted public notice by the exhibition of a picture, *The Nightmare*, in 1782. He was elected a Royal Academician in 1790, and a professor in the academy in 1799. He lectured on art and wrote eloquently on art subjects, but his pictures are very deficient in technical qualities and confused in composition. D. in London, Apr. 16, 1825. William A. Coffin.

Fusel Oil [Germ. *Fusel*, poor liquor, perh. from Lat. *fusilis*, liquid]: a collective name for a variety of alcohols and compound ethers which are produced during vinous fermentation, and which pass over with the alcohol when fermented liquors are distilled. It is, in fact, to the fusel oil that the different kinds of spirits owe their distinguishing qualities, as when the fusel oil is completely removed from them pure alcohol, more or less dilute, alone remains. Fusel oil varies with the material from which the spirits are prepared: that from the potato consists chiefly of amylic alcohol, with some propylic and butylic alcohol, etc.; that from Indian corn is chiefly amylic alcohol, with compound ethers consisting of the acetate, caprylate, formate, caproate, and œnanthylate of ethyl and amyl. Fusel oil from beet-molasses contains butylic and amylic alcohols, and compound ethers of valerianic, caproic, œnanthylic, caprylic, and pelargonic acids, with ethyl, amyl, etc. The fusel oil from marc brandy contains considerable propylic alcohol, with methylic, ethylic, butylic, amylic, and caproic alcohol. Ethylic or common alcohol is contained in all fusel oil. The following table exhibits the alcohols found in fusel oil, with their boiling-points and specific gravities:

NAME.	Formula.	Sp. gravity.	Boiling-point.
Methyl alcohol....	CH_3OH.	0·798	66·6° C. = 152° F.
Ethyl "	C_2H_5OH.	0·794	78·4° C. = 173° F.
Propyl "	C_3H_7OH.	0·820	96° C. = 204·8° F.
Butyl "	C_4H_9OH.	0·803	110° C. = 230° F.
Amyl "	$C_5H_{11}OH$.	0·811	132° C. = 275·6° F.
Hexyl "	$C_6H_{13}OH$.	.....	....

The following acids have been observed in fusel oils, either free or forming compound ethers with the alcohol radicals methyl, ethyl, etc.:

Formic..............	$HCHO_2$.	Caproic............	$HC_6H_{11}O_2$.
Acetic..............	$HC_2H_3O_2$.	Œnanthylic.........	$HC_7H_{13}O_2$.
Propionic...........	$HC_3H_5O_2$.	Caprylic...........	$HC_8H_{15}O_2$.
Butyric.............	$HC_4H_7O_2$.	Pelargonic.........	$HC_9H_{17}O_2$.
Valerianic..........	$HC_5H_9O_2$.	Capric or rutic......	$HC_{10}H_{19}O_2$.

Amyl alcohol, being in most cases the predominating constituent, is often called fusel oil, even when freed entirely from the other alcohols, etc. It is a colorless liquid, having a peculiar sickening odor which causes coughing. It has a burning taste. Sp. gr. 0·811 at 19° C.; boils at 132° C.; burns with a white smoky flame; freezes at —22° C.; is soluble in alcohol and in ether; nearly insoluble in water. The ordinary amyl alcohol consists of two liquids having the same composition and vapor density, but differing in optical properties—one rotating the plane of polarized light to the left, while the other is inactive. Some of the compound ethers of amyl derived from this alcohol, as the acetate, butyrate, valerianate, etc., constitute the fruit essences strawberry, pineapple, banana, apple, pear, etc., now so generally used for flavoring confectionery, sirups, etc.

Defuselation of Alcohol.—As the fusel oil has a higher boiling-point than common alcohol, it distills over with the last portions which come from the still, and in the column still, when the more condensable vapors are liquefied and flow back to the still, the greater part of the fusel oil remains behind. Thus alcohol nearly free from fusel oil can be obtained. To remove it completely other means must be resorted to. Filtration over fresh wood-charcoal is the process most generally employed. Sometimes the vapor of the alcohol is passed through a chamber filled with charcoal. The following substances have also been recommended: binoxide of manganese for filtration; slaked lime, soda lye, chloride of lime, manganate of soda, milk, olive oil, and soap. The process of aging or keeping really results in a partial defuselation of spirits; by oxidation the fusel oil is gradually changed, probably to compound ethers, and the flavor and *bouquet* of the spirits are greatly improved. Spirits are not considered suitable for medicinal use till they are two or three years old.

Detection of Fusel Oil.—On distilling whisky and other spirits, and diluting the distillate with water, it is often rendered milky by the fusel oil which separates. By allowing spirits to evaporate slowly from the hand, or from a glass which has been rinsed out with it, the peculiar smell of the fusel oil comes out after the ethylic alcohol has evaporated. By mixing ether with the spirits, and then adding water, which causes a layer of ether to separate, the oil may be extracted. On evaporating some of the ethereal layer on a watch-glass the fusel oil is left behind. Nitrate of silver is not a very reliable test, as it is blackened by a great variety of substances. See Fermentation and Whisky.

Revised by Ira Remsen.

Fusibility [deriv. of *fusible* < M. Eng. *fusible*, from O. Fr. *fusible* < Lat. **fusibilis*, deriv. of *fun'dere*, *fusum*, melt, pour. See Foundry]: the property by which solids become fluid when heated. Most solids are fusible; some, however, undergo decomposition without fusing. The temperature at which solids melt (the melting-point) differs greatly for different substances, but it is always constant for the same substance. The temperature remains constant during the entire period of melting. (See Freezing-mixtures.) Many bodies are usually liquid (melted), because the temperature of the air is much above their melting-points. Most solids when heated to their melting-points pass from solids to perfect liquids, but some pass through an intermediate pasty condition (*vitreous fusion*) before they become fluid. This property in glass enables workmen to blow and press it into form, and the forging and welding properties of wrought iron and platinum are due to the same circumstance. The *freezing-point* is the temperature at which the melted body solidifies; it is generally identical with the melting-point. We can, however, often cool a liquid below its melting-point without its solidifying. We may cool water, if we keep it perfectly still, to — 15° C. (+ 5° F.) without its freezing, but if we drop in a grain of sand or agitate it, it at once rises to 0° C. (32° F.) and freezes. A *change of volume* occurs at the moment of melting, usually an expansion, but in the case of water and a few metals it is condensation. The melting-points of bodies are slightly affected by pressure—that of ice being lowered, that of wax being raised. Substances which expand on liquefying have their melting-points raised—those which contract have their melting-points lowered. Mixtures, as of fatty acids, alkaline chlorides, or alkaline carbonates, or of metals (see Fusible Metals), often fuse at temperatures below the melting-points of the simple bodies. Fluxes (see Flux), partly by their chemical action in reducing compounds to the metallic state, and partly by presenting a readily fusible medium, promote the fusion of metals. The following table of melting-points is taken from Pouillet:

SUBSTANCES.	Centigrade.	Fahrenheit.
Mercury..........................	—39°	—38·2°
Ice..............................	0	+32
Phosphorus.......................	+43	109·4
Spermaceti.......................	49	120·2
Stearin..........................	49–43	120·2–109·4
Potassium........................	58	136·4
White wax........................	68	154·4
Stearic acid.....................	70	158
Sodium...........................	90	194
Iodine...........................	107	224·6
Sulphur..........................	114	237·2
Tin..............................	230	446
Bismuth..........................	202	395·6
Lead.............................	320	608
Zinc.............................	360	680
Antimony.........................	432	809·6
Silver...........................	1,000	1,832
Gold.............................	1,250	2,282
White cast iron..................	1,050–1,200	1,922–2,192
Gray " "	1,100–1,200	2,012–2,192
Steel............................	1,300–1,400	2,372–2,552
Wrought iron.....................	1,500–1,600	2,732–2,912

C. F. Chandler.

Fusible Calculus: See Calculus.

Fusible Metals: alloys which melt at comparatively low temperatures. It is a curious fact that alloys often melt at temperatures far below the melting-points of their constituents. Bismuth, fusing at 202° C. (395·6° F.), tin, at 230° C. (446° F.), and lead, at 320° C. (608° F.), form alloys which melt in boiling water. Cadmium lowers the melting-point still further. An alloy of 1 bismuth, 2 tin, 1 lead is used as a soft solder. The following table gives the name and composition of the principal fusible alloys, all of which can easily be made by simply melting the constituents together in the proper proportions:

NAME.	Bismuth.	Lead.	Tin.	Cadmium.	Mercury.	Melting-point.
Newton's	50	31·25	18·75	....	....	94·5° C. = 202° F.
Rose's	50	28·10	24·1	....	....	95° C. = 203° F.
d'Arcet's	50	25·0	25·0	....	....	94° C. = 201° F.
d'Arcet's with mercury	50	25·0	25·0	....	250·0	45° C. = 113° F.
Wood's	50	25·0	12·5	12·5	....	65° C. = 149° F.
Lipowitz's	50	26·9	12·78	10·4	...	65° C. = 149° F.
Guthrie's Eutectic	50	20·55	21·10	14·03	....	Stated to have the lowest melting-point.

D'Arcet's alloy is a most remarkable one; when it cools from fusion it expands while still soft, and when used for taking impressions of dies reproduces the finest lines with the greatest accuracy. One of the alloys containing cadmium has been used by dentists for filling teeth, being applied in the melted state with little tools like soldering-irons. Plugs of fusible metal, mixed to fuse at certain definite temperatures, have been suggested as safety-valves for steam-boilers. They are found, however, to undergo changes in use which modify their fusibility, making them entirely unreliable. Revised by IRA REMSEN.

Fusiyama: See FUJI-SAN.

Fustian [M. Eng. *fustian, fustan*, from O. Fr. *fustaine*, Ital. *fustagno* < Lat. *fusta'neum*, deriv. of Arab. *Fustāt*, a suburb of Cairo, whence it first came]: a cotton fabric resembling velvet. In addition to the usual warp and weft there is an additional weft, which is brought above the surface in loops. When these are cut the ends rising above the surface produce a short fur, which entirely hides the tissue beneath. This is smoothed by shearing, singeing, and brushing.

Fustic [from Fr. *fustoc*, from Low Lat. *fustis*, tree (= Lat. *fustis*, stick). Another form with equivalent meaning is *fustet*, from Fr. *fustet* < Low Lat. *fustetus*, fustet, fustic, deriv. of *fustis*, tree]: a name applied to several yellow dyewoods. (1) True fustic, tree-fustic, yellow Brazil-wood, old fustic, etc., is the wood of *Morus* (*Broussonetia* or *Maclura*) *tinctoria*, a fine large tree of the order *Moraceæ* growing in the West Indies and South and Central America. It affords a very permanent and valuable yellow dye, and is largely exported to Europe and the U. S. (2) Bastard fustic, which is believed to be a smaller variety of the same wood, but is inferior in quality. (3) Young fustic, fustet, or Venetian sumach, called also Hungarian or Zante fustic, is the wood of *Rhus cotinus*, a sumach-tree of the Levant, whence it is exported. It makes a brighter yellow than old fustic, but one which is not so permanent. No kind of fustic is of much practical value except when compounded with other dyestuffs. Mixed with other appropriate dyes, fustic is of great value in obtaining green, yellow, orange, brown and drab tints, and even blacks and reds; but it is necessarily excluded from blues, violets, purples, and kindred shades. The fustics are employed for cottons, woolens, and silks.

Fust, JOHANN: See FAUST.

Futa Jallon, foo'ta-jăl-lon': the southern part of French Senegambia; the highest of that portion of Western Africa in which the rivers Senegal, Gambia, and Grande have their sources. Its elevation may not average much above 2,000 feet, but some peaks are so high that they are said to be occasionally covered with snow during the rainy season. The mountains are rugged and abrupt, and clad as they are with dense forests, they present most striking and beautiful scenery. Timbo, the capital, is situated in lat. 10° 25' N. and lon. 10° 40' W.

Futtehpoor: same as FATHIPUR (*q. v.*).

Future Estate: in law, an estate which is to commence in possession at a future day; an estate in expectancy. Under this general designation are included estates in remainder, reversions, contingent, shifting, and springing uses, and executory devises. In New York an important change has been made by statute in the common-law system of estates, and the term "future estate" has been adopted as a specific technical name for all estates in expectancy except reversions, the various separate titles previously in use having been discarded. A "future estate" is there defined as "an estate limited to commence in possession at a future day, either without the intervention of a precedent estate, or on the determination, by lapse of time or otherwise, of a precedent estate created at the same time." Such future estates are declared to be vested or contingent. "They are vested when there is a person in being who would have an immediate right to the possession of the lands upon the ceasing of the intermediate or precedent estate. They are contingent while the person to whom, or the event upon which, they are limited to take effect remains uncertain." An exposition of the law relative to future estates will be found under the separate titles REMAINDER, USES, etc.

Future Life: See FUTURE STATE and IMMORTALITY.

Future State: the state of man after death.

I. ROMAN CATHOLIC DOCTRINE.—The Catholic Church teaches that the soul of each man, immediately after death, is judged and assigned to one of three states—heaven, hell, or purgatory. Heaven consists of the eternal beatific vision of God, to which those are admitted who pass from earth without stain, either because their life has been sinless or because their transgressions have been fully expiated. Hell is likewise everlasting, and is the infliction of a twofold punishment. Those who die in original sin only are there deprived of the beatific vision—*pœna damni*; those who die in grievous actual sin are subjected, moreover, to unending torment—*pœna sensus*. Purgatory is a temporary middle state in which those who depart this life in the grace of God are detained to expiate, by suffering, the slighter offenses not forgiven before death, or to complete the expiation of grievous sins which had been forgiven. Heaven is the destiny of these souls, who, after their works have been revealed, "shall be saved, yet so as by fire" (1 Cor. iii. 12–15). Their sufferings are alleviated by the prayers and good works of the faithful, inspired by the "holy and wholesome thought to pray for the dead that they may be loosed from sins" (2 Mach. xii. 46). Concerning the location of purgatory, its duration for each soul, and the precise quality of its sufferings, various opinions are held by theologians, but nothing is defined by the Church as matter of faith. At the final and general judgment, the Church teaches that soul and body shall be reunited, and that the risen body shall share for eternity the existence of the soul—the glory of heaven or the torments of hell. JOHN J. KEANE.

II. ORTHODOX PROTESTANT DOCTRINE.—The subjects discussed in this article are (1) the *intermediate state*; (2) the *resurrection*; (3) the *last judgment*; (4) the *blessedness of the redeemed*; and (5) the *punishment of the lost*.

The doctrine of the *intermediate state* has been somewhat fluctuating in its form, owing to the paucity of the Scripture data. The representation in the parable of Lazarus and Dives has furnished the basis of the general statement that the believer is happy and the unbeliever is wretched between death and the final judgment; yet the resurrection of the body adds somewhat to both the happiness of the believer and the misery of the lost. The majority of the ancient Fathers, in the opinion of Hagenbach, believed that men do not receive their full recompense of either reward or penalty until after the resurrection of the body. The Protestant affirms that at death the soul of a believer is made perfect in holiness. What precisely is the difference between the condition of a believer as disembodied and as re-embodied he does not affirm. He is content with denying purgatorial pains and purification, as well as an unconscious sleep of the soul between death and the resurrection.

The doctrine of the *resurrection* of the body was from the beginning a cardinal and striking tenet of Christianity. Perhaps no article of the new faith made greater impression at first view upon the pagan. When the philosophers of Athens "heard of the resurrection of the dead, some mocked, and others said, We will hear thee again of this matter" (Acts xvii. 32). All the early Fathers maintain this dogma with great earnestness and unanimity against the objections of skeptics, of whom Celsus was acute and scoffing in his attack. Most of them believed in the resuscitation of the very same body materially. Justin Martyr says that cripples will rise as cripples, but at the instant of resurrection, if believers, will be made physically perfect. The Alexandrine school alone adopted a spiritual theory of the resurrection. Origen went so far in this direction as to assert that a belief in the resurrection of the body is not absolutely essential to the profession of Christianity, provided the immortality of the soul were maintained. But these idealizing views were generally combated with great earnestness, and in some instances evoked an extremely gross and carnal view in opposition. The patristic theory of the resurrection passed into the Middle Ages with little variation. The poetry of Dante and the painting of Angelo powerfully exhibit it. In the Protestant Church the existence of a real body, and of a body that preserves the personal identity, is affirmed; but the materialism of the papal, and to some degree of the patristic, Church is avoided by a careful attention to St. Paul's dictum: "There is a natural body (σῶμα ψυχικόν), and there is a spiritual body (σῶμα πνευματικόν)."

The doctrine of the *last judgment* was, from the first, immediately connected with that of the resurrection of the body. Mankind "must all appear before the judgment-seat of Christ, that every one may receive the things done in his body" (2 Cor. v. 10). The Fathers founded their views of the day of doom upon the representations and imagery of Scripture. They believed that a general conflagration will accompany the last judgment which will destroy the world, though some ascribed a purifying agency to it. Some of them, like Tertullian and the more rhetorical of the Greek Fathers, enter into minute details, while others, like Augustine, endeavor to define dogmatically the facts couched in the figurative language of the Bible. In the Middle Ages representations varied with the bent of the individual theologian. One popular opinion was that the judgment will be held in the valley of Jehoshaphat. Aquinas maintained that the last judgment will take place *mentaliter*, because the oral trial of each individual would require too much time. In the modern Church the course of thought upon this doctrine has been similar to that in the ancient and mediæval. The symbols of the different Protestant communions explicitly affirm a day of judgment at the end of the world, but enter into no description. Individual speculations, as of old, vibrate between the extremes of materialism and idealism.

That the *blessedness* of the redeemed is endless has been the uniform faith of the Church. Representations concerning the nature of this happiness vary with the culture and intellectual spirit of the age and the individual. Justin Martyr regards the blessedness of heaven as consisting mainly in the continuation and increase of the happiness of the millennial reign. Origen holds that the blessed dwell in the aërial regions, and pass from one heaven to another as they advance in holiness: at the same time he condemns those who expect merely sensuous enjoyment. The Greek theologians Gregory of Nazianzus and Gregory of Nyssa follow Origen. Augustine believed that the heavenly happiness consists in the enjoyment of peace which passes knowledge and the beatific vision of God. One important element in it consists in deliverance from all hazard of apostasy—the *non posse peccare et mori*. The Schoolmen held the patristic theories, but with an endeavor to systematize. They divided heaven into three parts—the visible heaven, or the firmament; the spiritual heaven, where saints and angels dwell; and the intellectual heaven, where the beatific vision of the Trinity is enjoyed. The modern Church maintains the doctrine of everlasting blessedness in substantially the same form with the ancient and mediæval. The tendency to materialize or to spiritualize it varies with the grade of culture and modes of thinking.

The *punishment* inflicted upon the lost was regarded by the ancient Church as endless. The principal exception appears in the Alexandrine school, represented by Clement and Origen. But Clement is careful to say that the doctrine of endless perdition must be preached, in order to deter men from sin, although the hope of the final restoration of all is permitted to the thinker. Some faint traces of a belief in the remission of penalty in the future life are visible in the writings of Didymus of Alexandria. Gregory of Nyssa speaks more distinctly, pointing out the corrective design of punishment inflicted upon the wicked. The annihilation of the wicked was broached by Arnobius. The mediæval Church was likewise a unit in holding to the endlessness of punishment. The modern Church has also received the historical faith upon the subject, though a tendency appears in individuals and parties to the doctrine of a second probation and the final restoration of all mankind. The argument most relied upon is derived from the general nature of the Divine benevolence, rather than from the testimony of Scripture. It is generally allowed, even by opponents, that the Bible, taken as a whole, apparently teaches the doctrine of endless punishment, and especially that the descriptions which Christ gives of the transactions and decisions of the day of judgment preclude the idea of a second probation. W. G. T. SHEDD.

III. NON-ORTHODOX THEORIES.—Two theories respecting the future state of those who die impenitent, which differ radically from one another and equally from the Church theory, have found many adherents. 1. The theory of *conditional immortality*, i. e. that the human soul is not naturally immortal; also and perhaps more commonly called *annihilationism*. It asserts that immortality or eternal life is given only to those who have faith in Christ. Those destitute of such faith do at death pass into an estate of punishment, and are finally destroyed. The advocates of the theory appeal to the biblical assertions that the wicked are destroyed, and to the passages which set forth eternal life as the gift of God, and that those only truly live who are in Christ. The theory has been accepted as satisfactory by a large number of English Congregationalists, and by many in other communions at home and abroad. The classic work on the subject is by an English Congregationalist, Rev. Edward White (*Life in Christ*, London, 1875).

2. The theory of *restorationism*, or technically of *Apokatastasis*, i. e. that the time will come when the impenitent will repent, and then be restored to the favor of God. The term comes from Acts iii. 21, and the theory is defended on biblical and philosophical grounds, both in connection with the doctrine of the atonement and entirely independent of it. Such passages as Rom. v. 18, xi. 32, 1 Cor. xv. 22 are appealed to, and much use is made of the idea that the object of punishment in the future life is remedial and reformatory. The theory seeks to do away with the supposed dualism of the Church theory. It has been a favorite with speculative minds from Origen to to-day, and is predominant in the present Universalist Church in Great Britain and America, and held by very many in orthodox churches. Thus recently it has been ably defended by Rev. Thomas Allin (*Universalism Asserted*, London, 1888), of the Established Church of England, and by the late Rev. Dr. Samuel Cox (*Salvator Mundi*, 1877, and *The Larger Hope*, its sequel, 1883), of the General Baptist Church.

LITERATURE.—On the entire article, besides the appropriate sections in the systematic theologies, see W. R. Alger, *Doctrine of a Future Life* (with Ezra Abbot's well-nigh exhaustive bibliography; 10th ed. Boston, 1878); *Dorner on the Future State* (trans. and edited by Newman Smyth, New York, 1883); A. Hovey, *Biblical Eschatology* (Philadelphia, 1888); James Fyfe, *The Hereafter* (London, 1889); James Strong, *The Doctrine of a Future Life* (New York, 1891). For the discussion whether there will be a return of Christ to the earth prior to the final judgment of all mankind, see SECOND ADVENT; for fuller statement in regard to HEAVEN and HELL, see those articles. S. M. JACKSON.

Fuze [abbrev. of *fuzee*, *fusee*, *fusil*, from Fr. *fusil*, flint, gun < Low Lat. *focile*, hearth flint, deriv. of *focus*, fire (= Lat. *focus*, hearth)]: a device whereby an explosion may be effected at a safe distance from its destructive action. The charge may be in motion or be stationary, and a short, or a long, or an indefinite time may be desirable between the act of the operator and its effect. Hence numerous and widely different contrivances are employed.

For projectiles, including shells, shrapnel, carcasses, explosive bullets, and grenades, fuzes are now classified as time, percussion, and combination; a class "concussion" was formerly added, but it gave rise to confusion, and has been dropped. In modern practice both point and base fuzes are used.

Time-fuzes consist of cases of paper, wood, or metal containing the ingredients of gunpowder, varied to suit the required rate of burning. Being selected or cut to the proper length, they are inserted in the fuze-hole of the projectile, where, being ignited by the flame of discharge or by a match, they communicate fire to the inclosed bursting charge at the desired point of the trajectory. To this class belong most fuzes used with smooth-bore ammunition, such as the Bormann and its numerous modifications, the mortar, and the seacoast fuze. With rifled guns the length of the projectile, and in many varieties the rotating device, cut off the flame of discharge from a time-fuze, and thus prevent its ignition. In such guns the shock in the bore of the piece is utilized to ignite a time fuze of proper length for the range required. A primitive type of igniter was the "McEvoy attachment," consisting of a hollow wooden cylinder fitted to the projecting end of an ordinary time-fuze; within was a gun-primer loaded with lead, which, ignited by inertia at the discharge, fired the fuze. A better application of the same idea was displayed in the Sawyer fuze. Many other inventions, some mechanical and some depending on the use of fulminates, have appeared. Some utilize the shock of translation, and others that of rotation, to set off the igniter. Moreover, the greater time of flight due to the increase in range of modern guns has aggravated the old difficulty of obtaining a uniform rate of burning in the time-fuze composition, and researches in this direction are not yet ended. It may be desirable—as, for instance, in shelling a working-party with a view to interrupting its labor—to have mortar-shells fall in its vicinity liable to explode at any time within an hour. The McEvoy-Beardslee fuze was designed to meet this case. A small vial of sulphuric acid is placed in a plug containing chlorate of potassa and sugar, but separated from it by several thicknesses of slowly absorbing paper. The shock breaks the vial, and, after a time, depending upon the number of thicknesses of paper, the acid soaks through to the powder, detonates it by contact, and thus ignites the bursting charge.

Percussion-fuzes induce a desired explosion only after the projectile strikes the object. As this is difficult to effect unless a particular point is brought into contact, the class is practically restricted to use with rifled arms, or with grenades, like Ketchum's, provided with some guiding device. One of the simplest forms consists of an ordinary percussion-cap upon a gun-cone, placed within a plug at the point of the projectile; a small priming communicates the explosion to the interior. The cone may be fixed, or, as in the Parrott, Schenkl, and Absterdam fuze, be attached to a movable plunger. In the former case a thin exterior covering is crushed by the impact, and the cap is thus exploded; in the latter case the same result follows from the inertia of the plunger, which, when the projectile is suddenly stopped, brings the cap into violent contact with the thick exterior cover. For incendiary shells the Tice fuze belonging to this class was found to be serviceable in the civil war in the U. S. It contained a small vial of fulminate, which the shock of discharge left, by an ingenious contrivance, unprotected among some loose shot. They caused an explosion at the first impact, however slight. If the percussion-cap is made to ignite a time-fuze, or if other simple devices are employed, the explosion may readily be delayed; but it is hardly possible in any way to render the action so instantaneous as to prevent the projectile from burying itself before the fragments can be scattered by the bursting charge. Experiment has shown that a projectile fitted with an ordinary percussion-fuze imbeds itself in an old earthen parapet fully three-fourths of its maximum penetration before explosion. In breaching a masonry wall or penetrating an iron-plated ship this delay is advantageous, since it adds the force of the explosion to the original impact, and thus shatters and enlarges the crater, or carries destructive fragments of the plate and backing into the vessel. Indeed, it has been found well in the latter case to dispense with fuzes entirely, and to place the bursting-charge in a flannel bag, in order to retard the explosion which is produced by the sudden shock. For use against troops, however, the unavoidable delay is for obvious reasons objectionable.

The combination fuze consists of a time-fuze, with some additional device by which explosion results when the projectile strikes, if not before. One of the simplest fuzes of this class is the old Splingard, which consists of a time-fuze containing in its axis a long hollow cone of plaster-of-Paris open at the bottom. Weakened by the burning away of the supporting composition, this cone breaks and admits the flame at once to the interior at any impact occurring before the expiration of the time for which it was prepared. To the combination class belong the Schenkl fuze used in the U. S. during the civil war, the most elaborate form of the British Armstrong fuze, and many others of more recent date. Although both complex and costly, combination fuzes are in demand, owing to the enormous cost of modern projectiles, which forbids wasteful use. A good pattern has been developed experimentally at Frankford arsenal, largely through the efforts of Brig.-Gen. Flagler, ordnance department. The Hotchkiss point and Hotchkiss base percussion-fuzes are now regarded with favor; and a new type, the Merriam base percussion-fuze with delay action, has had favorable trials at Sandy Hook. Neither in the U. S. nor in Europe can it be claimed that perfection has been reached, although many fairly good shell-fuzes exist.

When the explosive is stationary, as in economic or ordinary military mining—including torpedoes planted for the defense of channels—quite different fuzes are necessary; which may be classed as time, contact, or electrical. The first class ordinarily consists of trains of quick-match, ignited by slow-match cut to a sufficient length to allow the operator to escape to a safe distance before the explosion. Various kinds of match are employed. Thus the Bickford fuze (gunpowder priming) burns from $2\frac{4}{10}$ to 4 feet per minute, the Ord fuze (guncotton priming) about 15 feet per second, and the Gomez fuse (fulminate priming) about 300 feet per second. The old powder-hose burned very rapidly, and was therefore usually ignited by a piece of port-fire which consumed at a rate of about an inch per minute. For military purposes, except in cases of necessity, these trains have been quite superseded by electricity; but the Gomez fuze, which is violently explosive, may sometimes be advantageously employed to spread combustion rapidly through large masses of gunpowder, such, for example, as the load of a fireship set adrift against a bridge or fleet. The primary ignition may be effected by clockwork so arranged as to release a trigger after the desired lapse of time. Contact fuzes for the torpedo service are analogous to percussion-fuzes for the artillery, and many devices are employed. A projecting lever may be so arranged that upon contact with a vessel it shall set free a trigger, and thus explode a common gun-cap. A similar plan has been used with drifting torpedoes designed to float freely with the current, coupled in twos by a rope. When the latter is fouled upon the anchor-chains the torpedoes are brought alongside, and held there by the tide, which is thus enabled to act upon a wheel armed with vanes like a windmill. The revolutions, transmitted to a screw axle, soon release a trigger, and thus cause a blow to be delivered upon a pin resting on a gun-cap. A sensitive fulminating priming, protected by a thin copper or lead cap so placed as to be crushed by the blow of the ship, is another form of this fuze. Still another consists of a bottle of sulphuric acid imbedded in a mixture of chlorate of potassa and sugar; the ship, by striking a projecting pin, breaks the bottle and thus ignites the torpedo. Ordinary cannon-primers may be so arranged as to explode the torpedo in a similar manner. Many of these devices are equally applicable to small mines buried in the ground in front of fortifications, to be fired by men or horses charging over them. The great objection to the whole class is that they debar a route to friends as well as to foes. Electrical fuzes, being perfectly under the control of the operator, obviate this difficulty. Many varieties, adapted to the different forms of electrical action, have been invented. The oldest contrivance, and that still most employed, is based upon the property possessed by a voltaic current of heating any poor conductor introduced into its circuit. A very thin wire of platinum, German silver, or iron, from a quarter to half an inch in length, is soldered so as to form a bridge between two stout parallel copper wires imbedded in a plug of wood, gutta-percha, india-rubber, or other non-conducting material. The free ends of these wires being attached to the leading wires from a powerful voltaic or magneto-electric battery, the passage of the current reddens the bridge and thus explodes a priming packed around it. The chief advantage possessed by these over other electrical fuzes is that they admit of easy and accurate testing by the passage of a current through them too feeble to heat the bridge dangerously. As the electrical resistance of the latter is usually less than an ohm, giving a current-strength requisite for ignition of from one-half to 3 ampères, this condition is easily fulfilled. For special purposes platinum fuzes, having a resistance of about 50 ohms, and requiring for ignition a current rather less than 0·02 ampères, are practicable. Various primings, such as gunpowder, guncotton, fulminating mercury, compounds of chlorate of potassa, etc., may be employed around the bridge. To intensify the shock, a metallic capsule charged with mercuric fulminate, either pure or mixed with chlorate of potassa, is added. These capsules are called "detonators," and are made with charges ranging from 0·3 to 2·0 grammes, according to the nature of the high explosive to be fired. Great caution is needful in handling detonators, for accidents with them are serious; but their use is imperative in economical blasting with most modern explosives. The old Beardslee fuze was adapted to an alternating magneto-electric current possessing a comparatively high electromotive force, although less than that from a frictional machine. The stout wires were connected by a very short plumbago line drawn with a soft lead-pencil upon the end of the wooden plug. The priming was good rifle powder. The electrical resistance of these fuzes was variable, ranging between 500 and 5,000 ohms, and their testing, although possible was not satisfactory. The von Ebner fuze, used in the Austrian torpedo service, is adapted to the extra current from a large primary coil, which, with an electromotive force rather less than that of most magneto-electric machines, may be made to possess enormous quantity. The fuze-bridge at first consisted of a plumbago line primed with fulminating mercury and a mixture of sulphuret of antimony and chlorate of potassa, but at present only the latter mixture is employed. To fire any considerable number of such fuzes as the foregoing it is necessary to make use of a derived circuit, and hence the explosion, although nearly, is not absolutely simultaneous. For a long time this was regarded as a serious objection with detonating compounds. To overcome it fuzes adapted to electricity of high tension, such as condensed frictional or secondary currents, have been prepared. They were made by replacing the bridge with a layer of some chemical compound which is so strongly polarized by the passage of the spark as to induce explosion. Such primings are the following, some of which, however, are sufficiently conducting to allow the use of magneto-electric, and even voltaic, currents. The Statham compound is subsulphide of copper; that of Abel is 45 parts of subsulphide of copper, 10 parts of subphosphide of copper, and 15 parts of chlorate of potassa; that of Dowse is fulminating copper; that of other parties (including Abel in his submarine fuzes) is fulminating mercury, with a greater or less proportion of some conducting substance, like graphite or powdered metal, added for conductivity. Of all this class, the fulminating copper priming makes the most sensitive fuze. It may easily be so prepared as to explode in a dry atmosphere when the exposed ends of the wires are brushed with a feather, or when an ebonite comb is passed through the hair of a person grasping one wire terminal, the other being insulated in the air. One hundred blast-holes may be fired simultaneously with such fuzes, connected in straight circuit, when a good ebonite frictional machine with a suitable condenser is employed; but it is needless to add that their use is criminally dangerous. Fuzes of the platinum wire type are now used to the practical exclusion of all others of the electric class. By suitably adjusting the battery power and the grouping of the fuzes, all requirements even for the largest blasts can be met—as, for example, at Hallet's Point, New York harbor, in 1876, when 3,640 fuzes were simultaneously fired without accident. They are exclusively used in the submarine mining service, and very largely in modern cannon. Even small-arms adapted to employ them are in the market. H. L. Abbot.

Fyens, fī'enz, or **Fienus**, fī-ee'nŭs, Thomas: physician; b. at Antwerp, in the Low Countries, Mar. 28, 1567; studied medicine with great success at Leyden and in Italy, whose schools then abounded with famous instructors; became in 1593 Professor of Medicine at Louvain, and soon had a European reputation for skill; was for a time court-physician to the Duke of Bavaria, and afterward first physician to the Archduke Albert at Brussels. Author of some very curious medical works, of which *De Cauteriis* (1598) and *De præcipuis artis chirurgicæ controversiis* (1649) are the most noteworthy. His works have only an historic value. D. Mar. 15, 1631.—His father, John Fienus (d. 1584), was a famous physician, author of a singular work, *De Flatibus.*

Fyke-nets: See Fisheries.

Fyrouz (fē̆e-rooz') **I.**: an Arsacide King of Persia (the name is also spelled Feroze and Firouze), usually identified with the Pacorus of the Greek and Latin writers, called also Arsaces XXIV. as King of Parthia; reigned 83–103 a. d. The name *Fyrouz* signifies "victorious."

Fyrouz II.: the seventeenth Sassanide monarch of Persia (the Perozes of Byzantine writers), reigned 459–483 a. d. He succeeded his younger brother, Hormuz, whom he overthrew by the aid of the White Huns and put to death. A dreadful famine marked the first part of his reign, and the king became involved in wars with the White Huns, who finally defeated him with great slaughter, Fyrouz and twenty-nine of his sons being among the slain. The accounts of historians regarding many points of his reign conflict.

Fyrouz III.: titular King of Persia; son of Yezdejerd III., the twenty-eighth and last Sassanide monarch, whose kingdom was overthrown by the Arabs in 641 a. d. Expelled by the Mohammedans from Persia, he fled to the domains of the Chinese emperor Kao-Tsung (Taï-tsung), by whom he was recognized, and who by fruitless negotiations strove to restore him to the throne. He is the *Pilouse* of Chinese historians, and seems to have been a Chinese viceroy in Bokhara. D. 679.

Fyrouz (or **Feroze**) **Shah I.** (Rokn-ed-Deen, the support of the Faith): a Mohammedan King of Delhi who succeeded his father, Altamsh, in 1236, having previously been governor of Lahore. He was a vicious prince, and was deposed by the Sultana Rezia, his sister, in 1236.—Fyrouz Shah II. (Jelal-ed-Deen, glory of the Faith) reigned at Delhi 1289–96; was an Afghan usurper who succeeded the last Gouride sovereign, and who is chiefly memorable for his cruelties; was murdered by his nephew and successor, Allah-ed-Deen, in 1296.—Fyrouz Shah III.: King of Delhi; b. 1296; succeeded Mohammed III. in 1351; abdicated 1386, and died 1388. His reign was memorable for its tranquillity and the material prosperity of the kingdom. He founded in 1354 a city now called Firozpur (*q. v.*), formerly Fyrouzabad, and began the construction of the great canal system now known by his name.

Fyzabad: See Faizabad.

APPENDIX.

Eimeo, ī'mē-ō: one of the Society islands; in the Pacific Ocean; about 30 miles N. W. of Tahiti. Taloo Harbor is in lat. 17° 30′ S., lon. 149° 47′ W. Eimeo is 9 miles long and 5 miles wide. The surface is diversified by valleys and hills, which produce excellent timber. There is a missionary station connected with the London Missionary Society. Pop. 1,500.

Einbeck, īn'bek: town of Hanover, Germany; on the river Ilme; about 40 miles S. S. E. of the city of Hanover (see map of German Empire, ref. 3–E). It has three churches; also manufactures of cotton and woolen goods and chemical products. A city of considerable importance in the fifteenth century and a Hanse town, it has since declined. It suffered severely in the Thirty Years' war, and its walls were razed by the French in 1761. Pop. (1890) 7,676.

Eisenerz, ī'zen-ārts (i. e. iron ore); also called **Innerberg**: a town of Styria, Austria; at the north base of the Erzberg; 20 miles W. N. W. of Bruck (see map of Austria-Hungary, ref. 6–E). The Erzberg, which is 5,000 feet high, is a solid mass of iron ore of rich quality. Mines have been worked here for 1,000 years. Eisenerz has twelve smelting-furnaces. Pop. (1890) 2,433.

Eisenstadt, ī'zen-staat (Hun. *Kis Márton*): market-town of Hungary; near the west bank of Lake Neusiedl; 12 miles N. N. W. of Oedenburg (see map of Austria-Hungary, ref. 6–F). Here is the Esterhazy palace, having 200 chambers for guests, a hall in which 1,000 persons can dine at a time, a library containing an invaluable collection of church music, etc. Connected with this palace are a zoölogical garden, an orangery, and a conservatory containing 70,000 exotic plants. Pop. 2,845.

Electro-ballistics: *ballistics*, derived from a Greek word meaning *I throw*, is the science which treats of the motion of bodies projected into space. As generally used, however, the meaning of the term is restricted to the motion of projectiles of regular form fired from cannon or small-arms.

To the military student three distinct branches of the subject are presented: 1. *Interior ballistics*, which treats of the motion of the projectile within the bore of the gun. 2. *Exterior ballistics*, which considers all the circumstances of the motion from the time the projectile leaves the muzzle of the gun until it strikes the target. 3. *Ballistics of penetration*, treating of the effects of the projectile upon the object struck.

In all phenomena pertaining to projectile motion the time-interval is the all-important one. The velocities are so enormous, varying as they do from 600 feet per second in the case of spherical shot fired from seacoast mortars to nearly 3,000 feet per second for projectiles from high-power built-up rifles, that the time consumed in passing over any limited portion of the trajectory, or path, is exceedingly small. The first essential, therefore, in the study of ballistics is some means of measuring accurately a very small fraction of a second of time.

The limits of this article will not permit of a discussion of the many theoretical and practical problems involved, but it is instructive to follow the various successive changes and improvements in ballistic apparatus, which have contributed so largely to the perfection of modern ordnance construction. All instruments of this kind now in use are controlled and operated by electricity, and the term *electro-ballistics* is generally employed to designate all the various means, methods, and instruments relating to ballistic investigation.

A great number and variety of instruments have been invented to determine the velocity of projectiles. The more important of these may be grouped under three heads: 1. *Gun pendulums*; 2. *Ballistic pendulums*; 3. *Electro-ballistic chronographs* or *chronoscopes*.

In instruments of the first class the velocity of the projectile is determined by suspending the gun itself as a pendulum and measuring the recoil imparted to it by the discharge. The mathematical expression for the velocity is deduced by considering the energy of recoil of the gun to be equal to that imparted to the projectile, the powder-charge, and the air.

Apparatus of the second class consist of a pendulum of sufficient size, thickness, and weight to receive the impact of the projectile without complete penetration, and the expression for the velocity is deduced from the fact that the energy of the projectile at the moment of impact is approximately equal to that of the pendulum and the projectile after impact, as shown by the amplitude of the vibration.

The results obtained from both classes of pendulum machines are only approximately correct, and their operation involves much complicated mathematical data. They are no longer in practical use on the proving-ground.

The employment of electro-magnetism to determine the velocity of projectiles was first suggested by Wheatstone in 1840. The velocity of the electric current through a conducting wire is so great that for all practical purposes its transmission may be considered instantaneous. In like manner the demagnetization of a soft-iron magnet-core may be considered to follow instantaneously upon the interruption of the electric current. The peculiar adaptability of electro-mechanism to instruments of this class was, therefore, soon appreciated and taken advantage of by ordnance experts.

Instruments of the third class are generally called *chronographs*, or *chronoscopes*, and sometimes *velocimeters*. They vary so much in the principles of construction and operation that it will be necessary to describe briefly at least one of each distinctive type. Before doing so, however, the general method of finding the velocity of a projectile will be explained.

Two wooden target-frames are set up a short distance apart in front of the gun, as shown at A and B, Fig. 1.

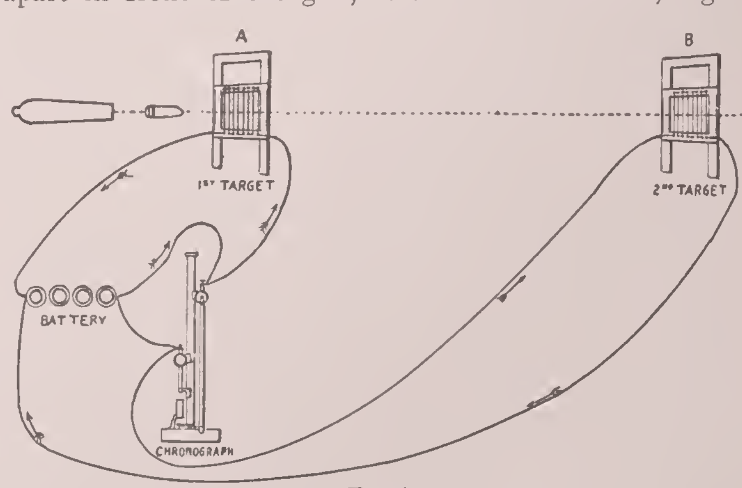


Fig. 1.

Over each frame is stretched a continuous bare copper wire, which is passed back and forth across the face of the frame in parallel strands. The strands are so close together that the projectile can not pass through the frame without breaking the wire at some point, and thus interrupting the electric current. Each target-wire forms part of an independent circuit from the battery, which also includes one of the electro-magnets of the chronograph. The chronograph and battery are usually installed at some considerable distance from the gun, in order that the shock of discharge may not disturb the more or less delicate adjustments. The projectile in passing through the first target breaks the circuit through the starting magnet and operates the chronograph; when it reaches the second target the circuit through the registering magnet is broken, and the exact time-interval between the two events is recorded.

The velocity of the projectile is found by measuring the time taken to pass over the distance between the two targets. As thus found, it must of necessity be an average or mean velocity for the distance. Since the actual velocity is a rapidly decreasing function of the time, it is important to have the distance or space-interval between the targets as short as possible, in order that the mean velocity may the more closely approximate the true velocity.

One of the earliest electro-ballistic machines of this class was that devised by the late Col. J. G. Benton, Ordnance Department, U. S. army, for the use of the cadets at the U. S. Military Academy. It is known as Benton's *chronometer* or *velocimeter*, and was the standard instrument of its kind in the U. S. for many years. Fig. 2 will explain its construction and operation. A graduated arc (*b*) is supported by a bed-plate of metal (*a*) and provided with spirit-levels and leveling-screws. The arc is divided into degrees and fifths of a degree, commencing at the lowest point of the arc and ending at ninety degrees on each side.

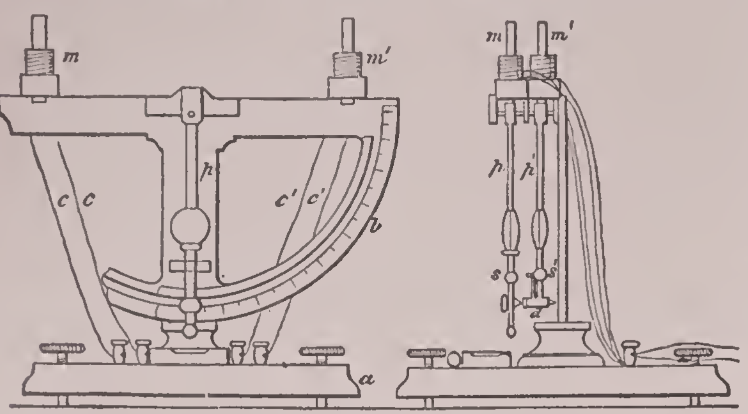


FIG. 2.

The two pendulums (p and p') have a common axis of motion passing through the center perpendicularly to the plane of the arc. The bob of pendulum p' is fixed, while that of p is adjustable so as to make the times of vibration of the two pendulums exactly equal. Two electro-magnets (m and m') are attached to the horizontal limb of the arc to hold up the pendulums when they are deflected through angles of ninety degrees. Soft-iron extensions of the pendulums (s and s') on coming in contact with the poles of the energized magnets hold the pendulums in the deflected positions. A contact device (d) registers on the scale of the arc the exact point at which the pendulums pass each other when released by interrupting the current around the magnets. This device is attached to the extremity of the suspension rod p', and consists of a small pointed pencil and spring inclosed in a tube. The point of the pencil is held near the surface of the arc, while the outer end is cut off obliquely to the surface.

As the pendulums pass each other a small projecting stud near the extremity of p strikes against the oblique end surface of the pencil, and thus leaves a distinct dot on the prepared surface of the arc. The position of the dot on the scale of the arc measures the interval of time that has elapsed between the two breaks in the electric circuits that release the pendulums in succession. The accuracy of the instrument is verified, and its adjustment tested, by breaking both circuits simultaneously and then regulating the length of pendulum p until the point at which they pass is exactly at the lowest, or zero, point of the arc. When the machine is in good condition and properly adjusted the position of the point of meeting seldom varies as much as one-tenth of one degree, an error which corresponds to only 0·000154 of a second of time.

The velocity of the electric current being so great, and the demagnetization of the magnets being considered simultaneous with the rupture of the circuits, it follows that the first pendulum begins to move the instant the projectile has cut the first target-wire and the second the moment the second target is reached, and the interval of time is measured by the difference in the arcs described by the two pendulums up to the time of meeting. From the known properties of these arcs tables are prepared which give at once the time-interval in fractions of a second for any given position of the point of meeting.

Boulengé Chronograph.—In Col. Benton's instrument, just described, the accuracy of the measurement of the time-interval was affected by the pivot friction of the swinging pendulums. The motion being constrained, the arcs as measured by the pencil-point differed slightly from the computed arcs, and thus introduced a varying error which was difficult to detect, and still more difficult to eliminate.

To overcome this defect, Capt. Le Boulengé, of the Belgian artillery, just after the close of the civil war in the U. S., devised an instrument in which the time between the two events is ascertained by the *free* fall of a heavy body during the interval, the beginning and end of which is made to accord with the occurrence of the events by means of an electric current.

This chronograph has been more generally used than any other of its kind, and although many changes in the electrical and mechanical details of its construction have been made by the inventor and others, it is still the same in principle, and is to-day considered to be the standard ballistic instrument of the world.

Figs. 3 and 4 show a side and front view of the chronograph installed upon a masonry or cement column ready for use. A and B are the two electro-magnets, in circuit with the targets. C is a long cylindrical rod of soft iron or low steel, held in suspension by the attraction of the core of magnet A. It is called the *chronometer*, and is provided throughout the greater portion of its length with a soft encasing cylinder of zinc. D is a short cylindrical rod of soft iron suspended from the core of magnet B, and is called the *registrar*. E is a substantial brass column which forms the support for the magnets. In the masonry foundation is a well, F, of a depth equal to the length of the rod C. G is a short brass cylinder which forms a pocket for the rod D to drop into. Supporting the cylinder G is a metal casing which contains a knife and spring with trigger attachment.

The practical operation is as follows: When the projectile breaks the circuit at the first target, the core of magnet A is demagnetized and the rod C drops. At the second target the circuit through B is broken, and the rod D, the registrar, is released. In falling into its pocket this rod trips the trigger of the knife and causes it to spring horizontally forward against the zinc casing of the falling chronometer-rod C. The cut thus made records the time. To eliminate as far as practicable from the results the various errors of time due to retained magnetism in the magnet-cores, the falling of the registrar into its pocket, and the time necessarily consumed in the mechanical operation of the knife-and-trigger mechanism, the operator before taking a record first locates the origin, or zero-point, of the chronometer-scale by suspending rod C from its proper magnet-pole, with the knife cocked. The knife trigger is then mechanically released, and the cut made on the casing of the suspended rod marks the origin. The rod D is then suspended from its magnet-pole, and the knife again cocked.

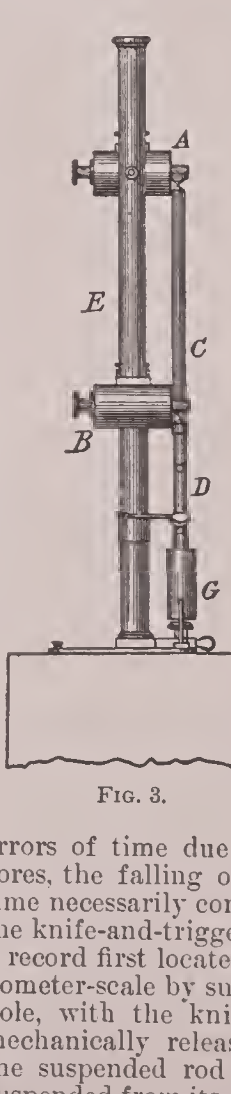


FIG. 3.

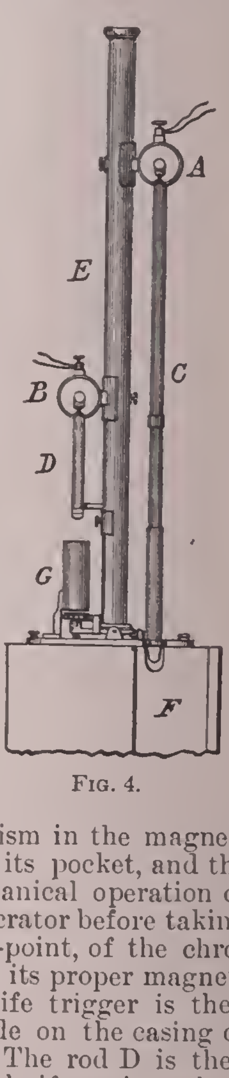


FIG. 4.

Now, if the circuit *through both magnets be simultaneously broken*, the cut made on the falling chronometer-rod will accurately measure the *sum of all instrumental errors.* The total instrumental error of the particular instrument used, being thus easily and quickly determined, is always subtracted from the actual chronometer record made in finding the velocity of the projectile. The certainty and ease with which this error can be found constitutes one of the most valuable features of the Boulengé chronograph.

The law of falling bodies is expressed by the equation

$$T=\sqrt{\frac{2h}{g}},$$

in which T is the time in seconds, h is the distance through which the body has fallen in the time T, and g represents the acceleration due to the force of gravity, or 32·2 feet. In the equation h corresponds to the distance measured from the origin of the chronometer-rod scale to the indentation made by the knife as the projectile passes through the second target. The correct values of T for all the different values of h used in practice are carefully computed by the formula given, and engraved upon a measuring-rule which is also provided with a convenient sliding vernier.

To take the record, the zero-point of the rule is inserted in the original indentation on the rod, and the vernier moved along until its knife-edge is brought against the inner edge of the indentation last made. The time in seconds is then read off directly from the scale. From the time thus found is subtracted the amount of correction due to instrumental errors (technically called the *disjunctor reading*), as already explained, and the remainder is the time consumed by the projectile in passing over the distance between the targets.

A reasonable amount of care is necessary in installing and adjusting the chronograph. The foundation should be a substantial one, and means must be provided for leveling the instrument. The current strength of each magnet should be just sufficient to support its rod, and no more, in order to obtain the greatest delicacy of measurement. The battery provided must therefore be of a voltage proportional to the total resistance of the circuit.

As already mentioned, the Boulengé chronograph is still the chief instrument in use for obtaining velocities. It has, however, undergone various modifications since its first introduction, particularly at the hands of Capt. Bréger, of the French artillery, and Capt. Holden, R. A.

The Schultz Chronoscope.—In the investigation of *interior ballistics* it is frequently necessary to determine the velocity of the same projectile at different points along the bore of the gun. It is also desirable, in determining the laws of the resistance of air to the motion of the projectile, to find the velocity at a number of different points along its path. For this particular work instruments of the Boulengé type are not well adapted, since they are primarily intended to measure but a single time-interval. The *Schultz chronoscope*, which was especially designed for the service indicated, and is the best known instrument of its type, will now be briefly described.

The cylinder a in Fig. 5 revolves by means of clockwork at a uniform speed of rotation, and at the same time is given a motion of translation by means of a threaded nut-bearing. The point b is attached to one branch of a tuning-fork c, and is either made to press lightly against the prepared blackened surface of the cylinder or it may be withdrawn from contact with it. The magnets d d are used to start the fork vibrating, to keep up this vibration during the experiment, and to equalize the amplitude of the vibration. Before using, the surface of the cylinder is coated with lampblack. As the cylinder revolves the point b traces a sinusoidal curve on its surface, and since the number of the vibrations of the fork per second are known there results an accurate scale of time. The record is made by a number of small electro-magnets, e e, placed in front of the cylinder, above the tuning-fork. Each magnet is provided

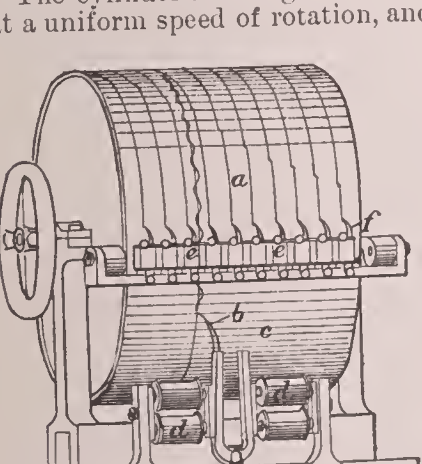


Fig. 5.

with a very light-pointed armature, f, which is held in its normal position and gently pressed against the surface of the cylinder by a small spiral spring.

When the current at a particular target is broken, the corresponding armature f is drawn quickly aside, and its point records the movement on the cylinder. The number of fork-vibrations between any two consecutive breaks is then counted, and this number divided by the number of vibrations per second gives the time-interval in seconds. To assist in counting the vibrations, the point b is first allowed to trace a simple helix on the surface of the cylinder before the fork is set to vibrating.

If the targets are such a distance apart that the current broken at one point can be restored before the next is reached, one register and one circuit is sufficient to record all the events; but, as this is seldom the case in practice, there are usually as many circuits and registers as there are events to be recorded. When determining bore velocities of the projectile, instead of the usual target-frames, a series of insulated electric circuits are arranged so as to be broken in succession as the projectile advances along the bore of the gun. The accuracy of the Schultz chronoscope is fully as great as that obtained with Boulengé's instrument, but it is so much more complicated, more expensive, and more inconvenient in every way, that it is used only in the special investigations indicated above.

Dunn's Chronoscope.—In 1890 Capt. B. W. Dunn, of the U. S. Ordnance Department, began a series of practical investigations and experiments, which has since led to the production of an instrument of the Schultz chronoscope type, and which is remarkable for its extreme accuracy and for its peculiar adaptability to the more technical refinements of ballistic study. Capt. Dunn's improvement consists essentially of a rotating photographic cylinder to receive the record, and the use of a massless beam of light, in conjunction with an induction or spark coil to make the record. The surface of the rotating cylinder is covered with sensitized paper. Instead of a tracing point, the tuning-fork carries a small perforated screen, which admits a single ray of light to the prepared surface, and as the fork vibrates a waving line is traced on the cylinder by the action of the ray. A second recording apparatus is provided which is adapted to act upon the same receiver. It consists of an induction coil, the primary circuit of which is broken by the projectile in its flight, and the terminals of the secondary coil are so arranged that the spark caused by the break in the primary leaves a mark on the paper at the side of, and close to, the waving line. The whole apparatus is operated in a dark room, there being means provided for admitting a single ray of light to the screen. The photographic record thus made is easily removed from the cylinder, and may be dated and filed for future reference.

While this instrument is not well adapted to the rougher practical experiments conducted on the firing-range, and would seldom be used in the ordinary determinations of powder-pressures and projectile-velocities in the service tests of new ordnance, it will prove of great value in the various manufacturing arsenals as a reliable aid to laboratory investigation.

The Crehore-Squier Polarizing Photochronograph.—A most ingenious modification of the Dunn chronograph has recently been produced in a complete instrument installed at the U. S. proving-ground at Sandy Hook, N. J., by the collaboration of Prof. A. C. Crehore, of Dartmouth College, and Lieut. George O. Squier, Third U. S. Artillery. It is probably the most expensive and elaborate, as well as one of the most novel, ballistic machines ever used. While the principles of operation are similar to those of the Dunn chronograph, the mechanical and electrical details of construction are radically different. The photographic receiver is inclosed in a dark box, and secured to a flat circular plate-holder, which is made to revolve rapidly at a practically uniform speed about a horizontal axis passing through its center by means of a small electric motor direct coupled to the shaft. A beam or pencil of polarized light is used, and, instead of the ordinary perforated screen, an ingenious massless shutter is provided by taking advantage of the well-known power of certain substances, when placed in a magnetic field, of rotating the plane of polarization. Such a shutter is not only without weight, but it has the further advantage of operating without mechanical movement, and thus avoids one of the most common and annoying sources of error. A Nicol prism is used to polarize the light, and a second similar prism, placed at right angles to the first, is employed as an analyzer. A beam of light falling upon the first prism is polarized, and the plane of the face of the second prism being perpendicular to that of the first, under ordinary conditions no portion of the polarized beam will pass through the analyzer, thus forming a shutter. If, however, liquid carbon bisulphide be placed in the path of the polarized beam between the two prisms, and then surrounded by a magnetic field of force, it will act to rotate the plane of polarization so that a portion of the beam will pass through the analyzer. As soon as the electric circuit that produces the magnetic field is broken the beam is again stopped.

The accompanying photograph shows the Crehore-Squier chronograph installed ready for work with the exception of the dark-box front and photographic plate. M is a small arc-light and projector which throws its beam upon the focusing lenses L L. P is the polarizer, T a glass tube filled with liquid carbon bisulphide, surrounded by the necessary magnetizing coils as shown. A is the analyzer, F a tuning-fork, the vibrations of which interrupt the emergent beam. W is a heavy wheel which carries the revolving plate-holder. A one-sixth horse-power dynamo, *m*, is coupled directly to the wheel-axle. In front of W is a thin metal cover which completely obscures the light from the sensitized plate except that admitted through a very narrow radial slit. A special shutter or cover is provided for this slit, which opens only when the instrument is ready for use, and remains open during one revolution only of the plate-holder.

The operation is as follows: The light from the projector passes through the polarizer P and traverses the liquid in tube T as a polarized beam until it reaches the analyzer A. Here the beam is completely stopped, provided no current is flowing in the coils surrounding the tube T. If, however, the electric current is flowing in these coils, the plane of polarization of the beam will be rotated to a greater or less extent according to the strength of the magnetic field, a portion of the beam will pass the analyzer A, and, after passing through a small perforated screen carried by a tine of the tuning-fork F, will enter the radial slit in the front of the dark box and fall upon the rotating photographic plate. As the projectile passes through the successive targets the current interruptions in the coils of T are thus accurately recorded upon the developed photograph. While this description is necessarily brief, it will suffice to explain the general operation. There are many details to be looked after, and experiments conducted with this instrument must be made with great care. The results are extremely accurate.

The Schmidt Chronograph.—A very compact and simple field chronograph has recently been brought out in France, and is now in use at the ordnance proving-ground at Sandy Hook. It is known as the *Schmidt chronograph*, and deserves mention here on account of the extreme simplicity of its construction and operation and the promise it gives of future usefulness in the every-day practical work of the proving-ground. It is, in reality, an electrically operated stop-watch especially designed for recording very small fractions of a second of time. It is portable, resembling an ordinary chronometer in size and appearance, and, as its adjustments are not appreciably affected by the shock of discharge, it can be set up near the guns, using its own battery-boxes as a supporting stand.

Fig. 7 shows a top view, and Fig. 8 a bottom view, of the instrument, together with the battery and wiring connections. The balanced wheel A is provided with jeweled pivot-bearings, and is actuated by a spring coiled about its axis, the spring being of sufficient length and tension to impart a practically uniform velocity of rotation to the wheel A for one complete revolution. The wheel A is made of non-magnetic material, with the exception of the large balanced spoke *c*, which is of soft iron. B is the starting magnet, the projecting core of which, through its attraction for the spoke *c*, retains the wheel in its initial position so long as the electric current is maintained around it. This magnet is in the first target-circuit. The stopping magnet C is in circuit with the second target. Its poles act upon the armatures *d d′*, which are fixed to the ends of the pivoted levers K K′, and so long as the current is unbroken the force of attraction holds these armatures in contact with the poles against the pull of the spiral spring L, which serves to bind the other ends of these levers together. When the current through C is interrupted the force of the spring is exerted to press these levers against the circumference of the wheel A, thus acting as an effective and quickly applied brake to arrest its motion. The axis of wheel A carries a pointer, I, which moves over an empirically graduated scale. The stop *g* is attached to a circular disk, and is moved by the thumb-piece *s*. A small adjustable reading-glass and vernier is provided to facilitate the reading of the fractional divisions of the scale. Inclosed in the same case are the usual electrical switches, resistances, and connections. Sufficient battery power is carried in two

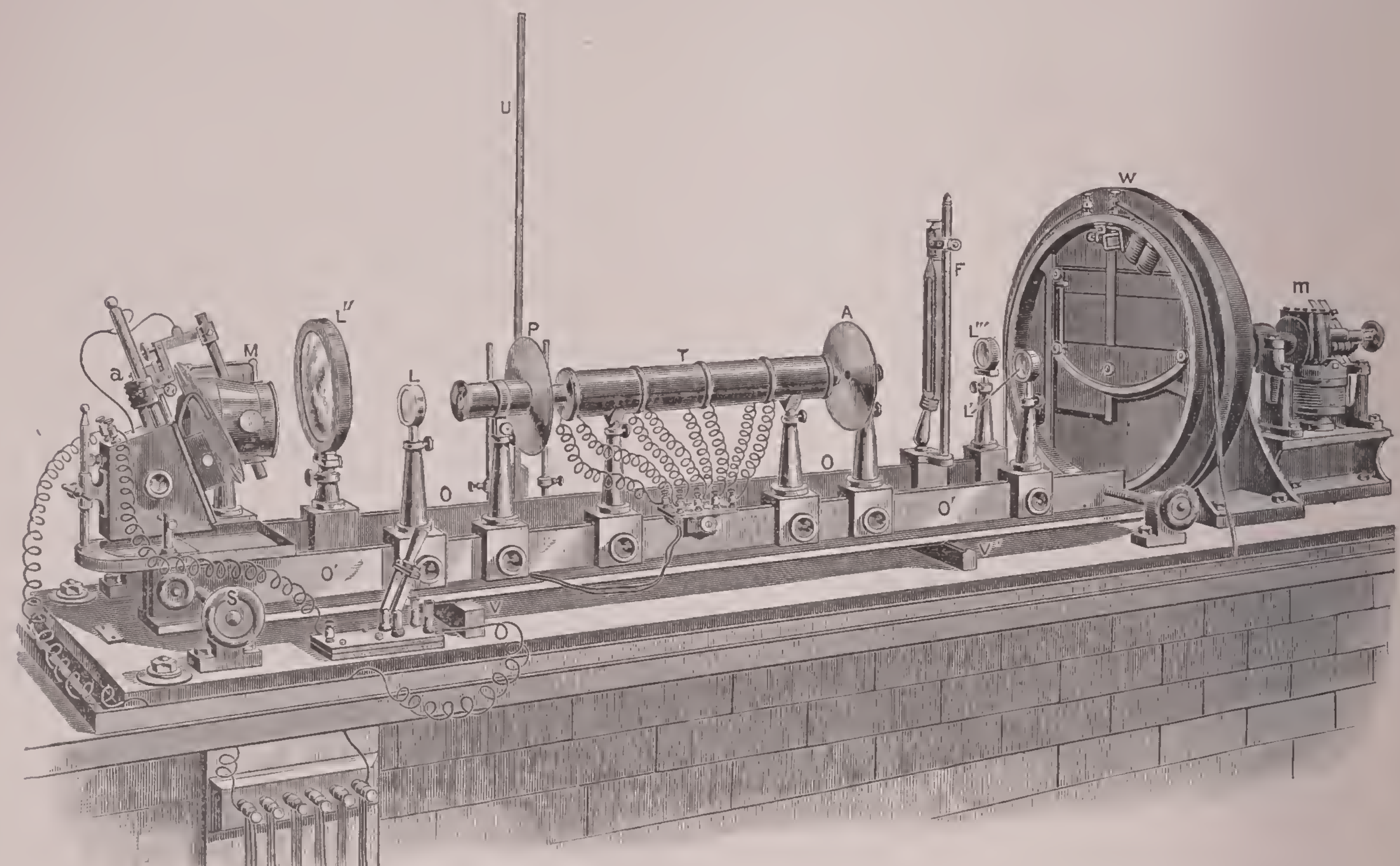


FIG. 6.—The polarizing photochronograph.

small battery-boxes, each containing a number of standard cells.

The operation of this chronograph is very simple. By moving the thumb-piece *s*, the setting disk and the stop *g* carry the pointer around to zero, when the armature spoke

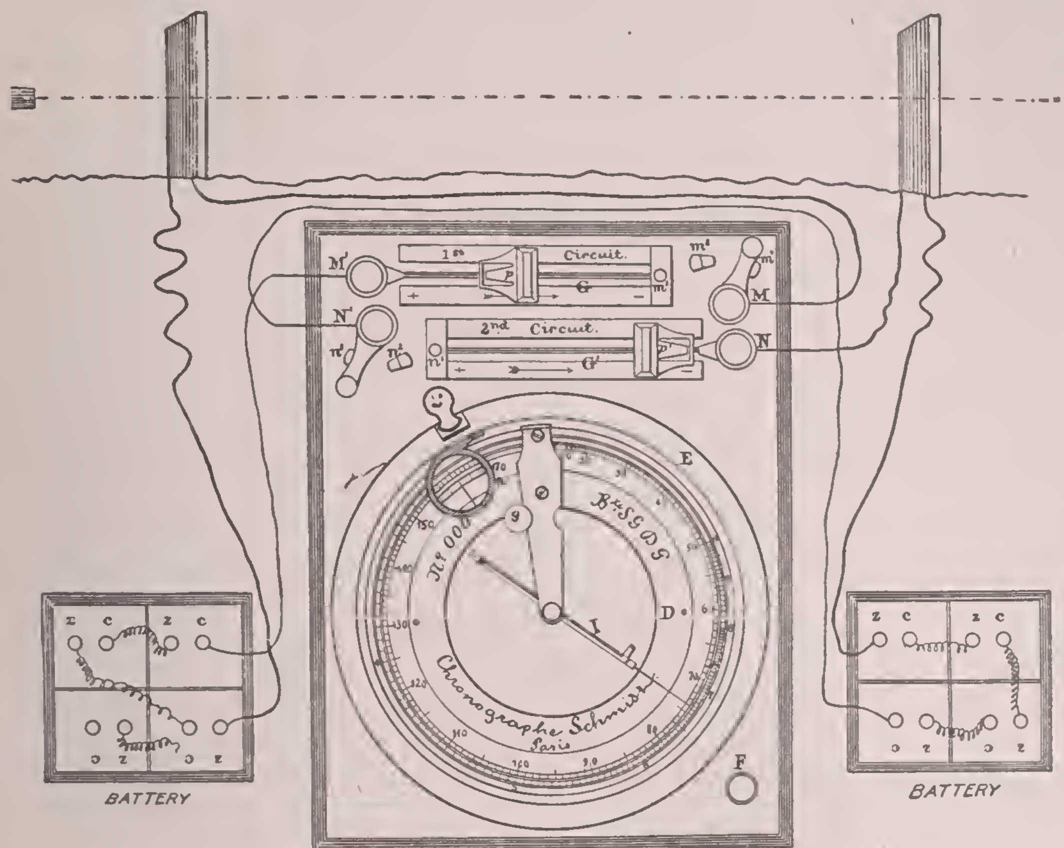


FIG. 7.—Schmidt chronograph, top view.

c of the balanced wheel A will be securely held, provided the current has first been established in the magnet B. The thumb-piece is returned to its original position as soon as the pointer is set at zero.

Now suppose both target-circuits to be established and the pointer at zero. The gun is then fired. As the projectile passes through the first target the circuit through magnet B is broken and the wheel A instantly freed. The

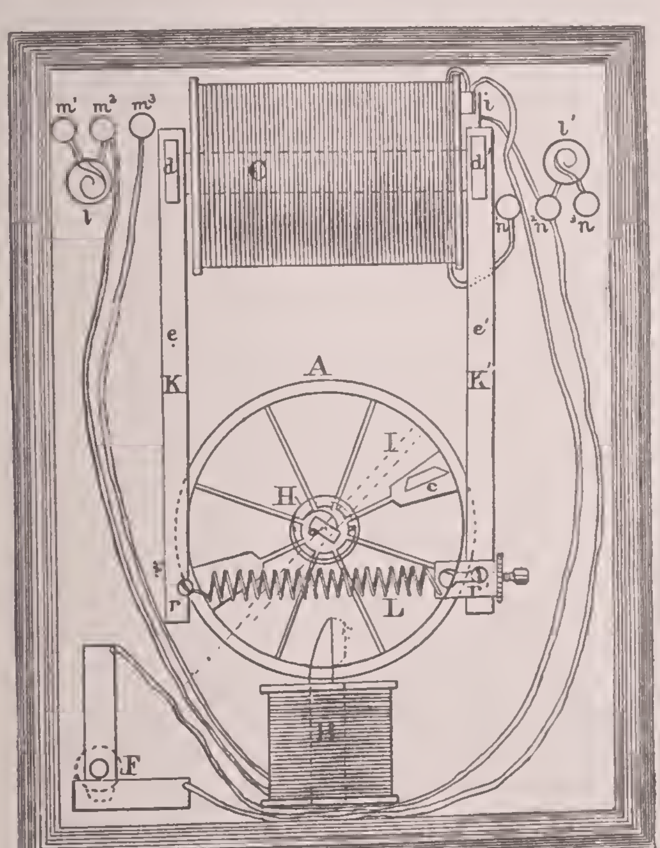


FIG. 8.—Schmidt chronograph, bottom view.

pointer flies around the scale until the second target is reached, when the magnetic brake is instantly applied by the interruption of the current in magnet C. The time-interval in thousandths of a second is then read directly from the scale. A second scale graduation gives directly the velocity of the projectile in feet per second. The targets used with this instrument should be placed at a given fixed distance apart, since the distance is assumed to be known in empirically graduating the scales, and it is made not too large (usually not more than 150 feet), since the movement of the pointer is limited to a little less than one complete revolution. I. N. LEWIS.

Elements, New Chemical: With the discovery of the chemical element argon as a new constituent in the atmosphere by Lord Rayleigh and Prof. William Ramsay interest in the study of the atmosphere and its constituents increased among chemists. The chief and most successful investigator in this domain of chemistry has been Prof. Ramsay, and at the meeting of the British Association in Toronto in 1897, in the address before the chemical section, he predicted the discovery of other elements besides argon and helium in the atmosphere. His more recent investigations have confirmed this view, and he has announced in succession the discovery of *krypton*, *xenon*, *neon*, and *metargon*. It does not necessarily follow that these bodies are all elements; still each has presented certain characteristics not hitherto recognized as belonging to other elements. Moreover, it must be remembered that these bodies exist only in very minute quantities in the atmosphere, they are exceedingly difficult of isolation, and their properties, as of all similar bodies, largely merge one into the other. A similar condition of affairs prevailed subsequent to the application of the spectroscope to the vapors of various compounds, which resulted in the discovery of a number of hitherto unknown elements in minute quantities; for instance, the discovery of cesium and rubidium in mineral waters by Bunsen. This method of investigation still continues a favored one, and has resulted in recent years in the announcement of *coronium* by Nasini, and of *monium* by Sir William Crookes. The discovery of the Röntgen rays has not been without its influence upon chemistry in the way of the announcement of new elements, and in Paris the radio-activity of certain compounds has been studied, notably that of the mineral pitchblende, which is of uncommonly complex composition. This has resulted in the announcement of the discovery of *polonium* and *radium*, possessing remarkable properties unlike any previously known among elementary bodies. For detailed information concerning the discovery and properties of these new bodies, see the names of those mentioned, in their alphabetical place. MARCUS BENJAMIN.

Elgon, Mt.: a mountain of East Africa, about 40 miles north of Victoria Nyanza. The meridian of 5° E. passes through its eastern foothills. Its height is 13,100 feet above sea-level. It was first visited on Dec. 30, 1883, by Joseph Thomson, the Scottish explorer, who found in the compact volcanic agglomerate of which the mountain is composed a considerable number of caves inhabited by natives, some of the caves being so large that they were occupied by whole villages with their cattle. In his opinion these caves were artificial, and were excavated in the rock in some past age by people superior to their present inhabitants. He saw only the caves near or at the base of the mountain, but six years later Messrs. Jackson and Gedge found inhabited caves at an elevation of 7,500 feet, one of which contained thirty large huts, and there were other cave villages farther down the mountain as well as at its base. Thomson's conclusion that the caves are artificial was combated by the later observers, who saw nothing to suggest that they might possibly be the work of man. They found evidence that many years ago the natives lived on the plain in ordinary villages, using the caves at times as a place of refuge from their enemies, until finally they made them their permanent abode. C. C. ADAMS.

Elk Lake: a small body of water south of Lake Itasca, Minn., and connected with it by Elk creek. It appeared on

Nicollet's map of 1836 as an estuary of Itasca, but later the outlet of Itasca was deepened by the current and that lake receded to a lower level, and a short creek now connects the two lakes. A traveler who visited Elk Lake in 1881 gave it his own name and announced it as the ultimate source of the Mississippi, and it so appeared in a geographical text-book used in the Minnesota public schools. By order of the Legislature, the lake under its new name was blotted on the school maps with red ink. The lake continues to be known as Elk Lake, which is the translation of its Indian name. It is not the ultimate source of the Mississippi, as several creeks tributary to Itasca spring from sources farther removed from that reservoir than Elk Lake. C. C. A.

Elliot, Arthur Ralph Douglas: British lawyer and author; b. Dec. 17, 1846; second son of the third Earl of Minto; was educated at Edinburgh University and Trinity College, Cambridge University, and called to the bar in 1880, practicing on the northern circuit; became a student and writer on political subjects; member of Parliament for Roxburghshire 1880–92, and for the city of Durham 1898; was made editor of the *Edinburgh Review* in 1895, which position he still holds. His publications include *Criminal Procedure in England and Scotland*; *The State and the Church* (1881); and other books and essays. F. S. A.

Ellis, Edward Sylvester, A. M.: author and educator; b. in Geneva, O., Apr. 11, 1840. He received education at the State Normal School, Trenton, N. J.; was a member of the faculty of the State Normal School of New Jersey 1857; vice-principal of the grammar school, Paterson, N. J., 1857–58; principal of the Trenton high school 1863–73; edited the Trenton *Public Opinion* (1874); was trustee and superintendent of the Trenton public schools 1875–85; edited *Golden Days*, Philadelphia, 1880–81. Besides numerous books for boys, such as the "Young Pioneer" series, the "Log Cabin" series, and the "Deerfoot" series (1874–99), he has published *An Eclectic Primary History of the United States* (1885); *The Standard Primary and Complete Arithmetic* (1886); *The Youths' History of the United States* (1887); *The People's Standard History of the United States* (1898); *A School History of the State of New York* (1899); and *A History of the World* (1899).

Ellis, Henry Havelock, L. S. A.: criminologist and author; b. in Croydon, Surrey, England, Feb. 2, 1859; was educated at private schools and at St. Thomas Hospital, England; taught in New South Wales 1875–79; returned to England and entered upon the practice of medicine, having qualified as a physician; gave up his practice for scientific and literary work, taking up his residence in Lelant, Cornwall. He edited the *Mermaid Series of Old Dramatists*, and his published writings include *The New Spirit* (1890); *The Criminal* (1890); *Man and Woman: a Study of Human Secondary Sexual Characters* (1894); *Sexual Inversion*, vol. i. of *Studies in the Psychology of Sex* (1897); *Affirmations* (1897); and other literary and scientific papers. He is a fellow of the Medico-legal Society of New York and of the Anthropological Society of Berlin; an honorary fellow of the Chicago Academy of Medicine; has been general editor of the *Contemporary Science Series* since 1889. F. Sturges Allen.

Elson, Louis C.: musical journalist; b. in Boston, Apr. 17, 1848, of German parents, and studied music there, beginning at the age of seven under his mother and continuing under the best of local teachers. He began his journalistic career as editor of the *Vox Humana*, and next joined the staff of the Boston *Musical Herald*. Subsequently he became music critic of the Boston *Courier*, and later of the Boston *Advertiser*. In addition to his journalistic work he has written several books which have become standard in their subjects. Among these are *The Curiosities of Music*; *History of German Song*; *The Theory of Music*; *The Realm of Music*; *European Reminiscences*, etc. He has delivered numerous lectures on musical subjects, and has been for many years Professor of Musical Theory, and lectures on musical history and criticism at the New England Conservatory of Music. He has directed several musical festivals in New England, and has composed and arranged a number of works. D. E. Hervey.

Elton, Charles Isaac: lawyer; b. in England in 1839; took his degree at Baliol College, Oxford University; became a fellow of Trinity College, Oxford, and a barrister in 1865; was appointed queen's counsel in 1885, and a bencher of Lincoln's Inn in 1887; is justice of the peace at Somerset, his country seat; member of Parliament for West Somerset 1884–85, 1886–92. Among his published works are *Tenures of Kent* (1867); *Commons and Waste Lands* (1868); *Copyholds and Customary Tenures* (2d ed. 1893); *Custom and Tenant Right* (1882); *Origins of English History* (2d ed. 1890); joint editor of *The Great Book Collectors* (1893): *Robinson on Gavelkind* (1897); and other books of a literary character. F. Sturges Allen.

Emery, Stephen A.: pianist and composer; b. in Paris, Me., Oct. 4, 1841. He studied at home first, and in 1862 went to Leipzig, remaining there for two years. Thence he went to Dresden, and finally returned home, settling in Portland, Me.; but in 1866 he went to Boston, where he remained for the rest of his life, teaching, composing, and writing theoretical books. His *Elements of Harmony* has become standard and is widely used. His compositions are very numerous, including many pianoforte pieces, solos and duets, studies, songs, and part songs. He died in the Massachusetts General Hospital, Boston, Apr. 15, 1891. D. E. Hervey.

Emotional Expression: Under "emotional expression" are included all the organic changes which accompany emotion and are said to express it. The term "facial expression" is used for the muscular changes of the face which show emotion, but the bodily accompaniments are much more widely extended. The heart is especially sensitive to changes of emotion: the breathing takes on altered rhythm, according as this or that emotion is dominant; the vasomotor system responds to these changes with compression or relaxation of the vessels, showing itself in blushing, flushing, paleness, etc.

Besides these general effects, there are certain well-marked sets of muscular contractions which go regularly with this emotion or that. The fact that they are regularly significant of certain emotions to the onlooker accounts for their being known as expressions, and they were considered literally as implanted means of expressing emotion until the rise of the evolution theory. A new construction of these muscular and physiological changes was suggested by Darwin in his famous work on *Emotional Expression in Animals and Man*. Darwin propounded the theory that the expressions have arisen as attitudes and actions which were of direct use to the animal in the struggles and rivalries, self-defenses and offenses, which the accompanying emotion at the time reflected and revealed. The expression of anger is, on this theory, a survival in the organism of the attitudes and actions, with their physiological counterparts, which the animal had to perform for safety and defense against other animals; that of fear, the attitudes of flight; those of affection, the attitudes of love-making, etc. This theory then says that emotional expressions are, in the first place, and in the majority of instances, "utility reactions" in the various storm and stress conditions into which the environment of things and other animals forced the creature's ancestors. The principle thus formulated Darwin called that of "serviceable associated habits."

This principle, now almost universally accepted, is associated, however, with certain others less widely applicable, but still necessary. Darwin formulated another law called that of "antithesis." There are certain emotional seizures which issue in expressions just the opposite of those which are accounted for by the law of serviceable associated habit or utility, expressions which seem to have no utility in themselves, and yet to be a sort of rebound and reversal of those which have utility. The emotions, also, in these cases, are the opposite of those which go with the useful expressions. Darwin accordingly held that such an expression is what it is because the emotion is just the opposite of that for which the antithetic expression has been useful. This is true as a matter of fact; but as Darwin left it, it is not an adequate explanation of the antithetic expressions. It assumes so-called muscular antagonism—the actual arrangement of the muscles in pairs—for the carrying out of the reversed expressions. But the theory of evolution has to account for just the fact of muscular antagonism. It has been pointed out, also, that the antithesis of movements in the organism goes much further back, being found in primitive organisms which have no developed muscular systems, and which react with approaching or withdrawing movements upon different classes of stimulating conditions in the environment. These contrasted attitudes are found in all life, and it has been suggested by later writers that it probably indicates some consciousness in the creatures, with variations in pleasure and pain; the reactions outward, toward stimulations, indicating pleasure, and those of withdrawal and inhibition, indicating pain. The law of antithesis, therefore, on this hypothesis, becomes that of "hedonic expression," the hedonic or pleasure-pain state being the real indication of what the actual attitude is to be.

A third principle, also intimated but not developed by Darwin, is that of "analogous feeling stimuli"—covering the fact that we take the same attitudes, expressive in character, toward things which feel alike, when the expression is appropriate, from the point of view of utility to one only of the similar stimuli. Let us say that a certain expression has arisen because of its utility for a certain sort of stimulation; then by this principle the same reaction or attitude is likely to be aroused by a stimulation which feels like the first, whether the expression be actually useful in the second case or not.

Finally, Darwin pointed out that many expressions are practically lawless, seem to be due to what he called "direct discharge" in the nervous system, without exhibiting any regular principle or purpose. This is especially true of intense emotions. When the regular well-recognized expressions have exhausted themselves, the system is thrown into a diffused convulsive contraction which is the reverse of useful. Thus the palpitation of the heart, the trembling of the knees, violent flushing, cold shivers, hot waves of sensation which sweep over us. These effects are probably due to the mechanical stimulation of the nervous system under conditions in which the ordinary pathways of discharge have not been adequate to carry off the agitation into which the organism is thrown.

The most general phenomenon of emotional expression—especially of the emotions which attach to personal situations and relationships—is the blush. This was also fully discussed by Darwin, who came to the conclusion that it is due to the direction of the attention to the person, and is hence confined to the parts which are visible to the eye of the observer—mainly to the face and neck. Mosso and others have found, however, that the blush extends more widely over the body; although the observations differ for different emotions, and the more widely extended flush is probably due to a general diffused vasomotor reaction of dilatation of the blood-vessels under excitement of the heart. This form of expression is referred to further under the heading MODESTY AND BASHFULNESS.

It is a growing opinion—based upon the so-called "James-Lange" theory of emotion—that, instead of being expressions of emotion, the bodily attitudes are really what is felt in consciousness as emotion; that, for the coarser emotions at any rate, the feeling is a revival or reverberation of earlier expressions of the utility type, established in the organism.

LITERATURE.—Darwin, *Expression of the Emotions*; Bell, *Anatomy of Facial Expression*; Mosso, *Fear*; Lange, *Die Gemüthsbewegungen*; James, *Principles of Psychology*, vol. ii., chap. xxv., and *Psychological Review* (1894), i., p. 516; Dewey, *Psychological Review*, i., p. 553, and ii., p. 13; Baldwin, *Mental Development in the Child and the Race*, chap. viii.; Lehmann, *Die Hauptgesetze des Menschlichen Gefühlslebens*. J. MARK BALDWIN.

Enneking, JOHN JOSEPH: artist; b. in Minster, O., Oct. 4, 1841. He was educated at Mount St. Mary's College; studied art in Europe 1873–76; returning to America, settled in Boston. Among his more noted paintings are *November Twilight* (two different scenes); *Winter Twilight*; *Summer Twilight*; *Cloudy Day in Summer*; *The Coming Storm*; *Indian Summer*; and *Springtime.*

Ephebe [from Gr. ἔφηβος; ἐπί, upon + ἥβη, youth]: a youth, or cadet, in ancient Greece. After the period of school training was passed, the youths about the age of eighteen entered the class of *epheboi*, in which they were trained for their duties in the defense of the state. In Sparta this period lasted for twelve years. The first two years were devoted to learning the use of arms and light skirmishing. At the end of that period they became *eirnes*, and entered upon a course of study closely resembling actual warfare. At Athens the service of the cadets lasted for two years, the first year being spent in the neighborhood of Athens and the second on the frontiers, where they became acquainted with the topography of the country and served as a sort of rural police. The facts in regard to the organization of the *epheboi* are known almost entirely from inscriptions. Some of the most important points on which there is reasonable certainty are the following: It was a state institution; it was altogether of a military character; at Athens it comprised both foot soldiers and horsemen; it was an aristocratic institution, not all the citizens passing through this discipline, but only the young people belonging to the three higher classes. At a later period foreigners were admitted to this band. The institution changed greatly, so that any description given would apply accurately only to a limited period. For example, in the fifth century B. C. it was obligatory and lasted for two years, but beginning with the third century it is no longer obligatory and lasts only one year. This special period of training between youth and manhood is one of the most interesting and striking features of Greek education. See Davidson, *Aristotle and the Ancient Educational Ideals*; Grassberger, *Erziehung und Unterricht im Klassischen Altertum*; and Girard, *L'Éducation Athénienne.* C. H. THURBER.

Epistemol'ogy [from Gr. ἐπιστήμη, knowledge + λογία, deriv. of λόγος, discourse] (or *Gnosiology*, or *Theory of Knowledge*, or *Rational Psychology*): the science of knowledge; that department of metaphysics which treats of the origin and process of knowledge, having as specific problems validity of knowledge, the nature of the soul, and its connection with the body. The problem of knowledge whose solution gives a "theory of knowledge" is resolved into two: (*a*) the process of knowledge and (*b*) the origin of knowledge.

Process of Knowledge.—Three general theories have been held as to the method of connection of the mind and its object—that is, as to the true analysis of the subjective and objective factors: (1) Representative theories, (2) formal theories, (3) immediate theories.

1. *Representative Theories.*—This problem is a late one in philosophy. Before men began to speculate they were undeveloped realists, and after the Greek intellect seized upon the general problem of existence they did not question the truth of things around them. The early Greeks had no theory of knowledge. But it became necessary as soon as the postulation of a metaphysical principle conflicted in any way with the reports of the senses. So Parmenides must criticise the senses in saying that change is not, and Heraclitus in saying that being is not. So "the senses deceive" is the first attempt at a theory of perception. This led at once to various attempts to reconstruct or deduce perception on the basis of mediateness. These attempts may be classified broadly on the bases of the mediatizing agent as twofold: (*a*) *The medium is material.* So in the Greek view. It rests on the principle "*similia similibus percipiuntur,*" the mind is conceived as different from matter, so some medium must be interposed. The difficulty seems less when, by refinement, the material *objectum quo* becomes intangible and vague—more like the mind which is in its essence warmth, air, atom, or some other invisible form—so the eidola of Democritus and the effigies of Lucretius, affluences, etc. Of course this is no longer held—if mind be matter, matter the *objectum quo* can act on it; if not matter, the *objectum quo* can not act on it. The principle of "like on like," however, does not hold. Like may, for all we know, and because of what we know, act on unlike, unless there be some hidden aspect of likeness between matter and mind. So viewed, however, it is true that there is a material medium, namely, our bodies, unless the mind be throughout the body. As far, then, as extra-organic objects are concerned, knowledge is mediate. When we push the question to the connection between mind and body, however, by the nature of the case no material intervention can help us. (*b*) *The medium is ideal.* Here the great problem of idealism confronts us. The idealistic view of things finds its justification in the process of knowledge. Disregarding for the present formal idealism, as concerned with the origin of knowledge as well as its process (for if the mind imposes forms, to this extent the content of knowledge is modified), we may say that the historic forms of idealistic thought rest upon the following positions: (1) The entire presentational *continuum*, considered as the sum of presentations, is ideal. Each germ of knowledge is necessarily subjective. The very fact that it is in knowledge clothes it with knowledge form. The subjective is an affection of self—an intensive state. Ideas, then, are what we know, and without its idea we know nothing. To Locke knowledge is the perception of the agreement or disagreement between ideas. (2) All relations of comparison, similarity, etc., arrived at in knowledge are relations between ideas,

whether there be things beyond them or not. (3) We can know no objective counterpart. If one exists we could never reach it, and it is more philosophical to say the ideas are the real objects of perception. (Locke had to assume substance; he confessed he could not reach it.) So for all idealism. Admitting the first two points, we may say of the third that it overlooks the possibility of an actual world to which the ideal world is true. Granting this, each point of the three may be supplemented by the consideration that sensation and ideation are themselves the immediate reports of this external world which is given to us intuitively. It is possible that a field-glass distorts, but it is also possible that it does not—that it is a perfect glass in all respects. But since the glass can never be removed from the eye, we can never know what is the truth. One conception is, on its face, as reasonable as the other. And all idealistic developments have a broad expanse exposed to this annihilating possibility. For this reason the first ground of idealism can never be proved nor disproved. This is Hume's position, and as far as empirical perception, both external and internal, is concerned, his arguments have never been answered.

More special forms, various modifications of this basis, are found. Hume and the Mills could go no further, because mind disappeared as matter did. If mind be reinstated, however, through the doctrine of immediate consciousness of self as acting and the validity given it which is denied to matter, we reach subjective idealism. Matter is no longer left unexplained; its efficient cause is mind. The difficulties of subjective idealism are: (*a*) The difficulty in passing from individual to universal mind. Berkeley was driven on the ground of his *esse est percepi* to the all-perceiving existence of God; but in so doing he gave up his justification of subjective idealism, since the immediate knowledge of self on which it rests is individual knowledge. Consistency in this position would lead to the individual construction of the world, and we should have as many worlds as minds, and no assurance of their sameness without external tests. So Fichte also, in his universal I. (*b*) This permanence and unity of the external afford a positive refutation of subjective idealism. The only way out is to hold the dependence of both mind and matter on another something which guarantees oneness in the manifoldness of microcosmic representation, and then this other is the real and not individual minds. (*c*) The negative criticism urged against all idealism holds here—viz., that even though we admit, as we do, immediate knowledge of mind as energy, the possibility remains that external energy is equally real though mediate. Here the same parallel may hold, as Spinoza would have it, between thought and extension, even though we admit the necessary phenomenal eminence of mind as necessary to the perception of either. If extension is real, in order to be known as real it must be interpreted as ideal; but this construction as ideal is used to destroy its reality. (*d*) On the basis of subjective idealism there is no possibility of the differentiation of objects in the external world. If there be nothing in objects of more than mental validity, whence this permanent and characteristic differentiation? Mental forms are constant, the matter of perception is varied, and hence mental form can not be the whole of the object; its matter can not come from mind. By these criticisms logically the idealist is driven to some form or other of absolute idealism. If mind be the efficient cause of the phenomenal world, and if unity and connection be the characteristic features of this phenomenal world, unity must be postulated in the mental world—viz., a universal mind which is at once the cause and ground of phenomenal mind and matter. This ground may be mind or matter, or we may not know whether mind or matter. Only the first alternative is idealism—a form of identity philosophy which is monism of mind. So the Hegelians and, in modified form, Lotze. This is logical and the necessary outcome of a representative theory of knowledge. Hamilton said there is no middle ground between natural realism and pantheism; so there is not if in pantheism we include all forms of immanentism (which is not correct), and if the great alternative of parallelism is overlooked with Kant and Hamilton. Absolute idealism, as idealism, fails in its theory of perception.

On the other hand, admitting the postulate of parallelism, we reach through a representative, but dualistic, theory of knowledge a theory of ultimate monism as satisfying to the demand of reason and more in accord with experience. The problem is to justify dualism from a representative theory of knowledge. All theories which hold a something back of the idea which gives it possibility, this something being the true, real, but unapproachable essence of things, are cosmothetic idealism or representative realism.

(2) *Formal.*—The opposition between the critical or formal theory of knowledge and the representative is seen in the fact that it arose historically as a refutation of sensational idealism. Kant's fundamental question, How is knowledge *a priori* possible? was the affirmative statement of the very inquiry that Hume has answered negatively. Though leading to idealism as thorough as any representative view, it is an altogether different conception at the first. The representative theories suppose something intervening between mind and matter, this something to represent either one or the other in the way of a mediator to their interaction. The formal theory, on the other hand, makes no such supposition. In its view the phenomenal world is a compound or synthesis of subjective and objective elements, and its problem is to analyze this compound and assign to its factors their respective worth. The beginnings of this view are to be found in Descartes's doctrine of innate ideas (see quotation in Lewes's *Problems*, 3d ser., p. 14), though it and subsequent similar views (Shaftesbury and German thinkers) had no direct reference to sense-perception. If looked at as forms at all, these ideas could only be considered regulative principles of knowledge—those subjective rules by which knowledge proceeds. They would not modify the content of higher knowledge nor endanger in any way its external validity. Indeed, the Anselmian proof, and the ontological proof based on the idea, is direct evidence that these ideas were considered to give peculiar assurance of the real validity of their content. With Kant a new turn was given to the doctrine of innate ideas.

Positive Element in Kant's Theory.—Against Hume Kant seeks to vindicate by a profound analysis of experience the existence of certain *a priori* rational elements not deducible from sense. These are original conditions of knowledge. They are present both in sense-perception and in the higher mental operations. In sense-perception they are space and time, the conditions of the perception of external things. In the higher operations they are the categories. These categories are the rational element in knowledge, supplied from the very constitution of reason. Their criteria are necessity and universality. These form a valid necessary basis for knowledge. But against Wolff, who held the absolute external dogmatic value of innate principles, Kant is just as positive. He holds that the judgments of reason are valid only when employed on a content, this content being necessarily matters of sense. Reason is only one factor of knowledge—the form; sense must give the matter, and these are inseparable in any valid sense. Outside the sphere of sense the categories are mere ideas or concepts, from which the existence of corresponding objects can not be deduced. In short, the categories are valid for knowledge when the senses co-operate; otherwise they are empty.

Negative Elements in Kant's Theory.—Thus Kant vindicates the presence and necessity of rational as well as sensible elements in knowledge, but he undoes his own work largely by the conception of their relation to the senses. The rational elements exist in the mind prior to experience as conceptual forms, which the mind imposes upon the matter of the senses, and thus largely constructs its own object. In the division of labor the world furnishes impressions, and the mind builds them into things. There is then a distinction between things as they are and things as we known them. Things as they are are things as we know them minus the contribution of mind, minus active construction in the categories. For example, we can not assert that things as they are are causes. So with all the categories (substance, etc.) in sense-perception, space, and time.

Content and Limits of Knowledge.—The result is an antithesis against knowing and being. The content is the constructed phenomenon: the real thing is unknowable. We know a real world exists, for a phenomenal world presupposes an intelligible world. The appearance implies the reality. The limit of knowledge is then exactly where Hume, or more truly Locke, assigned it. Knowledge is limited to the phenomena of cognition. It embraces positive (natural) science and formal (mathematical). This limit excludes from knowledge (1) the realities of the noumenal world, and (2) the objects of metaphysics—God, the soul, and the ultimate principle of the world. This inside these limits is pure agnostic or sceptical idealism, if made to apply to knowledge of self as well. Consciousness and intellectual forms are media.

These are the general features. As a theory of the process of knowledge it is open to these criticisms: (*a*) It can never be proved that while the content of knowledge appears in subjective form it is modified by that form; it is just as reasonable to suppose it is not; (*b*) the criticisms urged against subjective idealism hold here. (1) It leads to an individual construction of the world and can not reach universality—How do I know that you see things in the form of space and time? (2) If you go over to universal forms properly, the things in themselves are modified before they reach any perception, or we do not know whether it modifies them at all, and if not, things are what we see; (*c*) there is a great deal of empirical evidence for the derivation of space and time by a mental reaction on given physical data, which themselves carry specific differences as arising at localities. (*d*) If the categories are subjective only, no noumenon can be postulated, and we reach subjective idealism or sceptical idealism. (*e*) The status of the noumenal self is more direct than that of noumenal matter. The forms are forms of knowledge. If mind can contribute primary qualities nothing is left. Noumenon is well named as thought. (*f*) Parallelism can be supposed, as in all idealism, and as Kant does in practical reason (so Zeller). It would apply to higher truth as well as to sensation, and thus free the categories from dependence on sense-perception, giving validity to intuitions of mind apart from the special applications. (*g*) The presumption of empty and illusory processes is contrary to the general principle of adaptation in a reasonable universe. So here, as in subjective idealism, logical development leads to absolute idealism, as in Fichte's I and Schopenhauer's Will. So three distinct lines from Kant: (1) Insist on *limit*, reach phenomena only—sceptical idealism; (2) insist on noumenal—absolute idealism; (3) insist on forms—subjective idealism.

(3) *Immediate Theories: the Realistic View of the World.*—Realism takes two great forms: (1) natural realism (Scottish), and (2) transfigured realism (Spencer). (1) *Natural realism* was founded by Thomas Reid as a sure answer to Hume's sensational idealism. He reasserts the authority of common consciousness at the two points denied by Hume—(*a*) objective validity of sense-perception, and (*b*) objective validity of the higher judgments, causality, substance, identity, etc. In perception the idea of an object which arises from sensation is accompanied by an irresistible belief in the existence of the object. Reid does not teach that the mind directly cognizes objects, but that it has a spontaneous and irresistible belief in their existence, and this is equivalent to such cognition. In the higher sphere he holds that there are certain original beliefs or principles of common sense, carrying their own assurance of the existence of these objects. Common consent attests the validity of the principles Hume disputed in both spheres. Validity is assured by catholicity. Reid's theory containing the germ of natural realism was developed by Stewart and Hamilton. Hamilton completed the theory, maintaining that we perceive things directly, and removing Hume's subjective difficulty by distinguishing between the primary (objective) and secondary (subjective) qualities of matter. This could not meet Kant's formalism, for extension to him was subjective. Hamilton does not admit the validity of supersensuous things through common sense. His theory of the relativity of knowledge confines him to sensible realities. Mind can not conceive the infinite, etc. The most complete statement and defense of natural realism is found in writings of James McCosh. He improves Hamilton's theory of perception. He also insists on validity of higher intuitions, dividing them into cognitions, beliefs, and judgments, and making their tests primarily self-evidence, and secondarily necessity and universality.

Defects of Natural Realism.—(*a*) It rests upon a supposition—a dogma—viz., parallelism, which is only hypothetical and needs much criticism, i. e. of belief, reality, etc. If idealism were true the facts would be the same. (*b*) It is untrue in any sense which denies the intervention of the nervous system. (*c*) It denies the necessity of the subjective reconstruction of space and time. Subjective states are purely intensive and can in themselves have no extensive quality. Hence local signs or other spatial and temporal indications are in the last resort only representative symbols by which space and time are reconstructed, even though we claim parallelism. This is Reid's form against Hamilton's. So also with physical energy, which is manifested only in terms of motion or space. Allowing the validity of external causation, still external resistance and power are only by a true inference arrived at. This inference we may hold is as valid as intuition and is as truly realism. (*d*) The principle of common sense as resting on universality is extremely precarious. The study of infant psychology and evolution is deriving principles before considered universal. And the simple fact that the unreasoning intellect accepts a position as true is faint ground that it is true. For example, the doctrine that intuition is inherited nervous habit is held by Spencer.

Excellences of Natural Realism.—(*a*) It affords a consistent doctrine of the lower (sense) knowledge and the higher knowledge together. Immediate perception of the world with perception of higher truth as immediate makes a consistent theory. We can not divorce the two with Hamilton. So Kant's formalism is carried throughout the mental life. It is best also for empirical psychology and psychological science. (*b*) It dispenses with any unknown and occult substratum of matter, beyond what is at once present to the senses—this is the merit of Berkeley and is held by McCosh, who defines substance to being, permanence, and power. (*c*) It allows a like simplification of the concept of soul. The soul is what we know—conscious unity with varied activities—this is for knowledge the whole of soul-substance. Why assume in either case a thing-in-itself when we have sufficient data for a rational theory? We can say with Hume and Schopenhauer "perception is a closed relation," and no things can be reached outside it—but we need not say with them consequently we know no things. We know two things within this closed relation, mind and matter, both of which answer the conditions of permanent existence. What they called agnosticism (of the absolute) we may call dualism (of the conditioned), leaving the problem of the ultimate ground of the relation for the present unanswered. (*d*) It admits supplementing in the line of the subjective reconstruction of space—which is the mode of perception of space—and an immediate inference from the categories. (*e*) It may dispense with the support of common sense, which is adventitious and only of secondary importance.

(2) *Transfigured Realism* (Spencer).—Mr. Spencer has given his theory the name of transfigured realism to distinguish it from the realism of common sense on the one hand and from idealism on the other. It is a complex theory, and its understanding requires knowledge of its historical antecedents. The main sources are three in number: (*a*) From Hume and the association school it derives its psychological features and general view of experience. (*b*) From the evolutionists it takes the principle of development, and by its means is enabled to substitute for the idea of individual experience that of race experience. (*c*) From Kant and his British followers (Mansel, Hamilton) it obtains its transcendental element, i. e. association of an unknowable reality as the basis of knowable phenomena.

Two Fundamental Elements of the Theory.—The two corner-stones are his sensational psychology and his transcendental ontology, giving two phases of the theory—psychological and ontological.

Psychological Phase.—Mr. Spencer applies the principle of evolution to mental phenomena. After tracing the development of the physical basis of mind, and showing its relation to biology, Mr. Spencer, in the beginning of his *Principles of Psychology*, seeks to show in detail that the mental life develops in correspondence with the nervous system and is its function. The mind with its powers gradually arises out of physical conditions. This, however, is preliminary to psychology proper, which treats of mental and not of nervous phenomena—the fact of consciousness intervening. In treating of the development of the intellect in man, he begins with the elements of Hume (*Data of Philosphy*, in *First Principles*)—impressions and ideas—changing the names to vivid and faint states of consciousness. These elements arrange themselves into two series of states, which agree in some respects and differ in others, but never intermix. Of these two series the vivid one becomes objective and stands for the external world, while the faint one becomes subjective and stands for the internal world. The first step in development, therefore, is the differentiation of subject and object in consciousness. The process then continues as unfolded in detail in the *Principles of Psychology*. The mental powers—memory, imagination, reason, and will—arise out of the same elements. And, lastly, the judgments of reason which affirm the "philosophical relations" of Hume arise as judgments of association among states of consciousness. The result is not reached in the limits of the individual life, but is the accumulated result of the experience of the race. The psychological phase is therefore sensational, for it contains the fundamental assumption that reason is developed sense, yet it admits the validity of *a priori* judgments in the individual as given by heredity. It is open to the development toward the subjectivity of phenomenal or sensational idealism.

Ontological Phase.—Logically, phenomenalism seems to be the only ontological theory consistent with Mr. Spencer's psychology. But, in fact, he is a Kantian in his ontological views. He agrees with Hume, as Kant did, as to the limits of knowledge. But he differs from Hume and the positivists, and agrees with Kant in affirming the existence of a noumenal being at the basis of phenomena. This doctrine came from Kant through Hamilton and Mansel. So his ontology is transcendental. He reaffirms Kant's and Hume's limitations of knowledge to the phenomena of positive science. In this respect there is harmony among the three theories (sensational idealism, formal idealism, and transfigured realism). Kant's doctrine of a world of realities outside and behind the world of phenomena is reaffirmed, and this is, with Kant, unknowable.

Connection Between Psychology and Ontology.—On what grounds can he reconcile the two and ground assertion of unknowable real world? On the doctrine of causality, as usual. The existence of the phenomenal in consciousness involves existence of the objective outside of consciousness. This principle is stated in three ways: (*a*) Phenomenon implies ground; (*b*) relative implies an absolute; (*c*) effect implies cause. To be organic, on the ground of necessity of thought, the world can not stand of itself simply as phenomenal, but its reason must be found in something deeper. Experience can not give this deeper element, but reason demands the postulate to make experience itself intelligible.

General View.—Spencer defends realism against idealism and scepticism. Realism is superior to all other theories because of its priority, simplicity, and distinctness. The idealist, of whom he takes Berkeley as type, not only complicates knowledge by introducing a *tertium quid* between knower and object, but he must fall back on realism to get any subjective basis for his idealism. The sceptic (Hume as type) has no basis for a theory of things, for he must use reason to deny reason's authority, which is suicidal. In denying Hume's subjective conclusion that knowledge is limited to mental states he is true to facts, if not as true to logic. Consciousness knows nothing of subjective states, he says; it objectifies everything. It affirms both the external world and itself as objects. Hume denounces consciousness as mendacious, and points out such cases. Spencer recognizes the authority of consciousness, and while denying that we cognize objects directly *in se*, holds that our cognition is valid for us and reaches objective truths by an irresistible belief. It is impossible not to believe in such things as time, space, substance, energy, personality.

The validity of this theory can not be proved directly, but can by the *reductio ad absurdum* of all the other theories. So the realistic feature rests not on direct cognition, but on belief, which in turn rests on the rational principle of proceeding from relative to absolute, phenomenon to noumenon, cause to effect. We cognize phenomena; we have a rational belief in a reality under phenomena; but we can not characterize this reality. This view is similar to that of Reid, except that it is more ontological and representative. Reid's belief was in the identity of the phenomenal and real; Spencer's belief is in the real as underlying the phenomenal. Both postulate this belief as a mental necessity.

Criticism of Transfigured Realism.—(*a*) The principle of race experience does not help sensationalism; it is practically giving the case to intuitionalism because the problem is not our fathers' process of knowledge, but our own. If our *a priori* knowledge came from their experience it is still *a priori* to us. And if constant individual experience gives practical certainty (Mill), race experience gives moral certainty, even though we recognize nervous habit as its genetic basis. (*b*) It does no good to assert an unknowable. It is just as reasonable to see in phenomena the real which is knowable (parallelism). Spencer has not Kant's justification here, for he has no mental forms or activities by which the object is to be constructed. By pure sensationalism no contribution can be made to the object by mind.

Data for True Theory.—From the preceding history and criticisms the following principles seem to emerge: (1) If the external world is known at all it is known in knowledge form. (2) There is something outside the individual consciousness. (3) There is a consistent uniformity and differentiation in the phenomena of the external world. (4) There is a universal tendency of mind to believe in a substantial reality—outside. (5) The nervous system intervenes between mind and its object in sense-perception. (6) A single principle explains higher and lower knowledge. (7) Knowledge is possible.

Now some kind of a doctrine of parallelism alone can answer these conditions. The subjective side of the parallelism is represented in (1) and (5), the objective side in (2) and (3), and the fact that these are parallel is intimated in (4), (6), and (7). It can not be called inferential or representative, because in higher knowledge there is no inference nor representation. It can be called immediate only on condition that in the knowledge form things are absolutely true; that is, that there is no other reality than knowledge reality. It is certainly not a form of natural realism. It involves a subjective reconstruction of space. Some form of immanental monism is required by these presuppositions.

Origin of Knowledge.—The second problem concerns itself with the origin of knowledge. This is intimately connected with the problem of the process of knowledge. Admitting the possibility of valid knowledge, we find again three general classes of theories: (*a*) Empiricism, (*b*) sensationalism, and (*c*) intuitionalism. (*a*) Empiricism of origin corresponds at once with empirical idealism of process. The criticisms already advanced against the latter disprove the former. There is a tendency of mind to pass to an ultimate basis of knowledge somewhere, and complete scepticism is only the denial of this impulse. We hold also that mind as real is given immediately in consciousness. It is not to be denied, however, that the empirical view is sufficient for natural science, and has rendered valuable service in its insistence upon an analysis of the higher notions. Whatever notions are derived from experience let us give to experience. Yet its advocates admit that it can not give us certain knowledge, and just for that reason it is insufficient. Its latest form is "associationism" with the "units of composition" theory. Here Mill and Spencer, after Locke and Hume. (*b*) Sensationalism. Here the case is worse. We can not stop to examine it at length; its weakness is apparent enough in its history. It is fundamental contradiction, since the denial of inner experience is the denial of external experience. What is a sensation as such? A fine example of its futility is seen in Candillac's famous "statue." It leads over to materialism in philosophy, morals, and life. (*c*) INTUITIONALISM (*q. v.*). In general this is a theory that some truth is known by mind independently of experience, though not antecedently to it.

J. MARK BALDWIN.

Erben, HENRY: naval officer; b. in New York in 1832. He entered the Naval Academy in 1848, became passed midshipman in 1855, master in 1855, lieutenant in 1856, and in 1856–57 was employed in bringing camels from Egypt to Texas for the War Department; engaged in deep-sea sounding for the Atlantic cable; served in the China station 1857–59, and in the Gulf station 1860; in 1861 was instrumental in rendering Fort McRae useless to Confederates by spiking guns and destroying ammunition; was on blockading duty on the Gulf coast in 1861, and in the same year was in fights at Ship island and off Mobile with Confederate gunboats; took part in the bombardment of Fort Pillow in 1872, commanding the ironclad St. Louis; at the siege of Vicksburg commanded the Sumter, passing the batteries with Farragut; was in the battle of Baton Rouge, and in the engagement in which the Confederate ram Arkansas was destroyed in 1862; advanced to lieutenant, and became executive officer of the Patapsco in 1862; was in engagements at Fort McAllister and the forts below Charleston, S. C., in 1863; served with the Gulf squadron in 1864, capturing under the batteries at Matagorda, Tex., the armed schooner Dale and the boats of the torpedo station; was on duty at the New York navy-yard and in the South Atlantic station 1866–69; was promoted to commander in 1868; again on duty in New York, and commanded the school-ship St. Mary's 1871–82; advanced to captain in 1879; commanded the Pensacola in a cruise around the world 1883–84; after serving at the Portsmouth navy-yard, on special duty in New York, as a member of the board of inspection and survey, as commandant of the New York navy-yard, and as commander of the European station, 1885–93, and having been made commodore in 1892, he was retired as a rear-admiral in 1894. He commanded the patrol fleet in New York harbor during the war with Spain in 1898.

Errani, Achille: vocal teacher and tenor singer; b. in Milan, Italy, about 1824, receiving a thorough musical education, and singing tenor rôles in various Italian operahouses; went to the U. S. in 1860 and sang in opera under Max Maretzek's direction. In that year he married Miss Charlotte McWalters, and soon retired from the stage and devoted himself to teaching. D. Jan. 6, 1897. D. E. H.

Essipoff, Annette: pianist; b. in St. Petersburg, Russia, Feb. 1, 1850, and educated first at the conservatory there and subsequently a pupil of Theodore Leschetizky, who fell in love with her and divorced his wife in order to marry her in 1880. She made her first concert tour in 1874, after having made a favorable reputation in Russia. In 1876 she went to New York and played at many concerts and recitals. Since her marriage she has lived in Vienna with her husband. D. E. Hervey.

Etherion: a probable elementary gas discovered in the atmosphere by Dr. Charles F. Brush, of Cleveland, Ohio. Its chief characteristic is enormous heat-conductivity at low pressure, which experimentally has been found to be one hundred times that of hydrogen, the best gaseous conductor hitherto known. The new gas was obtained by partial separation from the air by diffusion. If its heat-conductivity is placed at one hundred times that of hydrogen, its mean molecular velocity at freezing temperature may be assumed to be more than one hundred miles a second, and its density only a thousandth part of that of hydrogen, while its specific heat will be six thousand times greater than that of hydrogen. A gas having properties like those mentioned could not possibly be confined to the earth's atmosphere; hence it probably extends indefinitely into space and forms a constituent of interstellar atmosphere. It was in recognition of this probability that it was named etherion, meaning "high in the heavens," by its discoverer, who suggested that perhaps it is the ether of the physicist, to which such remarkable properties have been ascribed. It is proper to add that Sir William Crookes in reviewing the announcement of the discovery of this new gas considers it more probable "that etherion is a water-vapor than that it is a new elementary gas." Marcus Benjamin.

Europe: The population of Europe at the close of 1887 was 343 millions, and at the end of 1897 it was 379·7 millions; an increase of 36·7 millions in the decade, or 1·03 per cent. increase for each year. In 1887 an average of 35 persons lived in each square kilometer, and 39 persons in 1897, or an increase in density of population in ten years of 4 persons to the square kilometer. The most densely peopled countries are Belgium, 200 to the square kilometer; the Netherlands, 133; Great Britain, 118; Italy, 104; Germany, 87; France, 72; and Switzerland, 71. Russia made the largest increase in the decade, 17·4 per cent., with 103·6 millions of inhabitants in her European domain. Russia, Norway, Finland, and Sweden are the states of lowest density of population.

The views of geographers with regard to the boundary between Europe and Asia have conflicted from the earliest times, and are not yet in accord. *Bevölkerung der Erde* gives various estimates for the area of Europe, according as one or another boundary line is accepted. Some map-makers give the Ural and the Caucasus Mountains as the boundary, while others follow the political divisions Russia has chosen to make, extending the European province of Perm to the east of the Ural Mountains, and including the whole of Caucasia, both north and south of the Caucasus Mountains, in her European domain. Geographers generally agree that the natural boundary of Europe in the east and southeast does not consist of mountains, but of the wide zone of depression extending from the Sea of Azov eastward to the north of the Caspian as far as the Ob basin and down the Ob valley to the Arctic Ocean, which was once covered by an arm of the sea that connected the Mediterranean with the Arctic Ocean. While, however, the true line of separation is in dispute, it is agreed that the decided contrasts between Asia and Europe fully justified scientific men in dividing them into two continents. C. C. Adams.

Eustis, James Biddle: statesman; b. in New Orleans, Aug. 27, 1834; received a classical education; graduated at Harvard Law School in 1854, was admitted to the bar in 1856, and practiced in New Orleans until the beginning of the war, when he entered the Confederate army; served a year as judge-advocate on the staff of Gen. Magruder and later on Gen. Joseph E. Johnston's staff until the close of the war, and then resumed the practice of law in New Orleans; was elected a member of the Legislature before the passage of the Reconstruction Acts, and went to Washington as one of a committee to confer with President Johnson on affairs in Louisiana; was a member of the State House of Representatives in 1872, and State Senator 1875–78; U. S. Senator 1877–79; Professor of Civil Law in the University of Louisiana 1879–85; U. S. Senator 1885–91, and again thereafter practiced law in New Orleans; appointed minister to France in Mar., 1893, afterward becoming ambassador extraordinary and minister plenipotentiary, and held the latter office until Mar., 1897.

Evans, Arthur John, M. A.: b. in Nash Mills, Hertfordshire, England, in 1851; graduated at Oxford in 1874, and afterward studied history at Göttingen University; traveled through some of the least-known European regions, making antiquarian and ethnological research, twice exploring the Finnish and Lapp countries between the Arctic and the Baltic Sea, investigating the survival of heathen rites there; traveled in southeastern Europe in 1875, and wrote letters to the *Manchester Guardian*, partly republished under the title *Illyrian Letters*; later published *Antiquarian Researches in Illyricum*, and accounts of new discoveries of Illyrian coins in the *Numismatic Chronicle* and other periodicals; in 1882 was expelled from Austrian dominions, after a short imprisonment in Ragusa under the charge of complicity with insurgents; in 1883 became university lecturer at Oxford, and in 1884 keeper of the Ashmolean Museum; in 1889 published *The Horsemen of Tarentum*, a monograph on the coinage of that city, in 1892 *Syracusan Medallions and their Engravers*, and in 1893–94 edited and supplemented the fourth volume of Edward A. Freeman's *History of Sicily*.

Evans, De Scott: artist; b. in Boston, Ind., Mar. 28, 1847. He received education at Miami University 1863–65; studied art without instruction; opened a studio in Cleveland in 1874, giving special attention to portrait-painting; studied under Bouguereau in Paris in 1877–78; returned to Cleveland and became instructor and co-director in the Academy of Fine Arts there; was noted for skill in representing draperies. His pictures include *The First Snowfall*; *Grandma's Visitors*; *Day Before the Wedding*; *The Flirtation*; *Morning*; *Wading in the Brook*; *After the Pose*; and *Christmas Morning*. He painted *Winter Evening at Lawnfield*, a picture of the Garfield family, for the reception-room of the Garfield monument in Cleveland.

Evans, Sir John, D. C. L., LL. D.: scientist; b. in England in 1823; educated by his father, the Rev. A. B. Evans, D. D., head master of Market Bosworth Grammar School, Leicestershire. He has been prominent for many years in connection with archæological, geological, numismatic, and other scientific investigation. In 1864 he published *The Coins of the Ancient Britons*, for which he received a prize from the French Academy, and in 1872 *The Ancient Stone Implements, Weapons, and Ornaments of Great Britain and Ireland*. Among his other writings are *Flint Implements in the Drift*, published in the *Archæologia*, and many papers in the *Numismatic Chronicle*. He was president of the Geological Society 1875–76; of the Anthropological Institute 1878–79; and of the Society of Antiquaries 1885–91; has been president of the Numismatic Society since 1875, and was president of the British Association for the Advancement of Science in 1897. He is a trustee of the British Museum, correspondent of the Académie des Inscriptions, and honorary member of many foreign societies.

Evans, Robley Dunglison: naval officer; b. in Virginia, Aug. 18, 1846; educated at Gonzaga College, Washington, D. C., and the Naval Academy, Annapolis. In the civil war he took part in both attacks on Fort Fisher, and was so seriously wounded that he was retired from active service. After his recovery he was restored to the service at his own request. He was stationed at the Philadelphia navy-yard in 1866, receiving his commission of lieutenant July 25 of that year; was on ordnance duty at the Washington navy-yard the following year; and was assigned to the Piscataqua, flagship of the Asiatic squadron, in 1869, having been commissioned lieutenant-commander Mar. 12, 1868. He was stationed at the Washington navy-yard in 1870; at the Naval Academy in 1871; and was ordered to the Mediterranean as navigator of the Shenandoah in 1873. In the following year he became executive officer of the Congress and returned to the Mediterranean, remaining there till the Congress was ordered to Philadelphia for the Centennial in 1876. He was in command of the training-ship Saratoga 1877–80, being commissioned commander July 12, 1878. He was stationed at the Washington navy-yard in 1880; served as lighthouse inspector 1882–86, and as chief inspector of steel for new cruisers 1886–87. For the following two years he served as secretary of the lighthouse board, and was granted leave of absence from Oct., 1889, to July, 1891. During the Chilian imbroglio of 1891 he commanded the Yorktown; from 1892 to 1894 was secretary of the lighthouse board, receiving his commission of captain June 27, 1893, and in 1894 was ordered to the command of the New York. In 1896 he was put in command of the Indiana; in 1897 became a member of the lighthouse board; and in 1898 was put in command of the Iowa, which was assigned to blockade duty off the coast of Cuba during the war with Spain, and which took a prominent part in the battle of July 3 near Santiago. In Oct., 1898, he was appointed a member of the board of inspection and survey. He published *A Sailor's Log* in 1901.

Ewing, Thomas: lawyer and soldier; b. in Lancaster, O., Aug. 7, 1829; served at the age of nineteen as secretary of the commission to settle the question of the boundary between Virginia and Ohio, and later was one of the secretaries of President Taylor; graduated at Brown University in 1854; studied law at the Cincinnati Law School, and in 1856 began the practice of law in Leavenworth, Kan. He rose rapidly in his profession, represented Kansas in the peace conference assembled in Washington in 1860, and at the age of twenty-nine was elected first chief justice of the Supreme Court of Kansas; was active in the struggle to make Kansas a free State; was colonel of the Ninth Regiment of the Kansas Volunteer Infantry, recruited and organized by him in 1862; for gallant conduct was made brigadier-general Mar. 11, 1863. He was severely criticised for his order No. 11, issued while in command of the "District of the Border," from June, 1863, to Feb., 1864, in which he directed the inhabitants of a large portion of the three border counties of Southern Missouri to remove to the military posts or out of the border. After the war he was active in political affairs until 1880 in Ohio; was a member of the Ohio Constitutional Convention 1873–74; member of the 45th and 46th Congresses; in 1879 unsuccessful Democratic candidate for Governor of Ohio; from 1882 devoted himself to the practice of law in New York city, where he was one of the founders of the Ohio Society of that city, and for three years its president. D. Jan. 21, 1896.

Expert Testimony: in law, the testimony of expert witnesses, or, as they are commonly called, experts. The function of an expert witness is to examine a real or supposed case of facts and interpret them. They are called to give their testimony because, by reason of their special knowledge or skill in the matter in question, they are able to interpret or give accurate opinions concerning them where other men would not be qualified so to do. Their function is to give their opinions or judgments merely as witnesses of a matter of fact, actual or supposititious, presented to them, to aid the final judges of fact (the court or jury, as the case may be), but not to bind them. Notwithstanding the opinion either one way or the other of the expert witness employed to testify in any matter or proceeding at law, the final judgment as to the actual facts of the case, which shall be binding upon the parties to the litigation or proceeding, is for the jury, judge, or referee, as the case may be. The expert witness judges of the relation of the phenomena which he sees or perceives by his senses to the general rules of the science or art in which he is skilled or learned; but he has no part in the judgment as to the relation of the facts involved in the case to legal rules. He usually states what in his opinion would be a fact upon the supposition that certain other facts are true. It has been asserted frequently that on the Continent of Europe the opinion of the expert is binding on the court, but this is not properly so. Although the opinion of the expert has rather more weight and influence than in the American and English law, and his position is one of more responsibility and trustworthiness, still he does not exercise any control over the final decision of the case by the court or other final judge of the fact or law.

Expert witnesses are called in legal proceedings to give opinions for the assistance of the court or jury in determining the conclusions to be drawn in matters which require special skill or training to understand and properly interpret. The most important of such matters are: identification of handwritings; valuations of property, especially real property or works of art or *vertu*; matters involving chemical analysis or other questions of scientific knowledge or research, especially the science of medicine; matters involving special knowledge of some trade or art; and, in short, any matter of such a nature as to require an extended previous study or association or acquaintance in order to give an exact knowledge of it.

The History of the Introduction of Expert Testimony.—The practice of introducing experts as witnesses in the trial of actions or proceedings at law for the better determination of the matters involved by those having the decision of them dates back as far as the time of the Roman Empire, and to all intents and purposes is probably as ancient as the history of man. Thus among the ancient Jews, in a trial of any matter at issue between parties litigant, all the spectators present at the trial of a case or question were required to give their testimony as to the matters involved so far as they were known to them, and this undoubtedly involved the statement of opinions as to anything on which a person present might be specially qualified to testify. Under the Roman law, however, we find that the judge (*judex*) had the discretionary right to summon expert witnesses (*artis experti*) to give him information as to certain physical ailments and other matters. In England there is a decision as early as 1553 A. D., by Saunders, J., in which it is said: "If matters arise in our law which concern other sciences or faculties we commonly apply for the aid of that science or faculty which it concerns, which is an honorable and notable thing in our law, for thereby it appears that we do not despise all other sciences but our own, but we approve of them and encourage them as things worthy of commendation." The testimony of medical experts seems to have been first recognized in the German Empire in the reign of Charles V., and was incorporated in the "Caroline Diet" of 1532. It is now recognized under the writ *de lunatico inquirendo* (freely rendered, concerning the inquiry as to lunacy), and is considerably used both in civil and criminal cases in which are involved the cause or manner of injuries and death, the determination of the existence of sanity or insanity, the effects of given operations or substances on the health, and many other matters concerning which a knowledge of the laws and practice of medicine is necessary to an intelligent opinion.

The Province of the Expert Witness.—The province of the ordinary witness is to testify as to actual facts observed; in the case of the expert witness a state of facts is supposed to exist, and, assuming that state of facts actually to have existed, the expert witness is called upon to state his opinion of the result or proper interpretation of such a state of facts. Generally speaking, also, the expert witness must base his opinion on facts which he has heard proved during the trial of the question in issue.

No strict division or specialization can be made as to when any one person may testify as an expert witness. He is qualified to testify when it is proved that he has received such a practical education or experience in the matter involved as to enable him to render an intelligent and probably accurate opinion of it in accordance with the rules of the art, profession, or trade to which it pertains. The court passes on the fitness or unfitness of an expert, the decision being subject to the right of the parties to appeal.

The opinion of an expert witness is inadmissible when the subject of inquiry does not require any peculiar preparation or study to understand it, and where persons of ordinary intelligence and education may form a judgment as to the matter involved, or where the witness can not and does not know more about the subject-matter than the jury, and must make his inferences from facts already in the possession of the jury.

The two most important fields for expert testimony are the identification of handwriting and questions of medical fact.

Experts for the Identification of Handwriting.—The determination of the identity of handwritings is one of the most important subjects of expert testimony known in the modern law—not only because facilities for producing forgeries have increased with the growth of the arts and sciences, and especially the introduction of typewritten and printed documents, but also because of the enormous multiplication of the use of written documents. The forgery of wills and notes has greatly increased within recent years, and also the forgery of testimonials, stock certificates, and other evidences of debts or obligations. But with this increase of facility and frequency in the forgery of written documents there has been a corresponding increase in the facility and means of detecting forgeries, so that the expert witnesses as to identification of written documents, or of the times of the writing of different parts of written documents, all parts of which purport to have been written at the same time, have correspondingly increased in number.

It is well settled that each individual develops a certain characteristic habit of writing due to the complexity of his mental activities and capacities, with certain typical variations due to one cause or another—such as the practice of various systems of penmanship, etc. For the identification of handwritings no positive rule can be formulated, because no parallelisms are apparent in the writings of different persons, owing to the complexity of the causes which give to each person his individuality; but in determining peculiarities certain elements are usually considered—such as the dominating use of the hand or forearm in writing, the pen-pressure, the effect upon the lines of excitement, fatigue, disease, or old age; variance of signature from the ordinary handwriting; the effect of instruction, etc.

In the Roman law the comparison of handwritings and the making of comparisons was assigned to experts. Under the common law the general rule is to exclude any writing made especially for a comparison; and in the U. S. this rule substantially prevails in the New England States, in Mississippi, Ohio, Kansas, Iowa, Texas, New Jersey, and New York, the jury being the judge as to whether the writing used as a standard is genuine or not. In some States genuine writings which are already properly in evidence in the case may be used for comparison by the jury, and such comparisons in a number of States may be made by experts. The cases where handwritings made for the purpose of the comparison are admissible are technical and governed by special rules, legal decisions, or statutes. Photographic copies are generally admissible.

The determination of the contemporaneousness of the production of parts of the same document, or papers purporting to constitute one document, frequently involves the analysis of the ink employed in the writing, the appearance of freshness or antiquity of the writing, the identity in manufacture of the paper used, the shape of the letters if typewritten or printed, the character of the impression, the words and peculiar meaning of words and idiomatic expression involved, etc.

Medical Expert Testimony.—Medicine is the most frequent, as well as the most important, branch of science in which expert testimony is required in courts of law, and most frequently affects the physical and personal welfare of those who are suspected in the matters at issue, involving, as it does, the questions of poisoning and insanity. In order to qualify a physician or other person to be an expert witness in matters of medicine, it is not necessary that he should be a follower of any particular school of medicine, but merely that, as already stated, he should be possessed of such knowledge as will, in the judgment of the court, qualify him to give an intelligent opinion on a statement of facts, actual or assumed.

Where the medical expert testimony involves the physical sciences—such as analysis of the blood, measurement of the body, the analysis of the remains of the body for poisons, conclusions as to the form of death in certain cases (as, for instance, whether death was from strangling or from a sudden blow or contusion)—the opinions of expert witnesses are especially valuable. But in those cases involving theories of disease—theories as to the operation of certain substances upon the body where the conditions of administration, amounts administered, etc., can not be definitely fixed—the opinion of an expert witness is less valuable. This is especially true in cases involving the decision of the questions of insanity. Here the opinion of the witness is based upon the actions of the subject, as interpreted by him at a time when he is in personal contact with the subject. The question as to what constitutes insanity is still unsettled; the inclusiveness of the term is continually widening, and the theories of the various schools of medicine, medical experts, and experts in criminality are widely different. See INSANITY.

In testifying as to the insanity of a person, experts ordinarily give their opinions as to the cause of mental unsoundness and its general effects. It is usual to furnish the witness, as basis upon which to form an opinion as to the existence of sanity or insanity, with more or less actual personal contact with the subject, and also with facts relating to his past habits of life as stated by witnesses acquainted with him. Generally speaking, in a majority of the States laymen (not physicians) may state their opinions as to the sanity or insanity of a person as a result of their personal observation of the person in question, they first stating what facts they have observed. In the State of New York, however, a layman can not express such an opinion unless he be a subscribing witness, in which case he may state whether the acts to which he testifies were in his opinion rational or irrational. In Massachusetts the restrictions on the testimony of laymen as to sanity or insanity are still more strict.

Fees of Expert Witnesses.—The right of the expert witness to special fees is not yet well settled. In general, especially in the U. S., it may be said that where the case is one involving the public safety, and to that end requiring the testimony of an expert, he may be subpœnaed to testify in the same manner as any witness; but that otherwise he may demand such reward as he sees fit, as a condition of giving his testimony. But when an expert has testified as a witness in favor of one side or the other, he can not refuse to be cross-examined on the matters concerning which he has testified.

The Value of Expert Testimony.—Expert testimony is indispensable to the administration of justice in the courts. But the uncertainty of many of the rules governing such testimony, as in the identification of handwriting, and the uncertain state of knowledge as to many other matters of investigation, such as the question of insanity, coupled with the unlimited fees that may be demanded by and paid to expert witnesses, combine to throw great discredit upon expert testimony in many cases. In actual practice a case seldom occurs where expert witnesses of the highest character, both for learning and uprightness, can not be obtained to testify so as to support both sides of the question in issue. As a case in point on the question of identity of handwriting, reference need only be made to the Dreyfus case in France; and on the question of insanity, to the case of Guiteau in the U. S. See Greenleaf's *Treatise on the Law of Evidence*; Thayer's *Evidence at the Common Law* (1898); Lewis's *The Law of Expert Testimony* (1894); Clemens Herschel's *Experts in Judicial Inquiries* (1886); Head *v.* Hargrave, 105 U. S. 45; Bonnier, *Preuves*, s. 119 (5th ed.); *Value of Expert Testimony*, by Nathaniel C. Moak; vol. i. of Wharton's *Treatise on the Law of Evidence in Criminal Issues*; Hagan's *Disputed Handwriting* (1894); Stephens's *Digest of Law of Evidence*; Rogers's *The Law of Expert Testimony.* F. STURGES ALLEN.

Expert Witnesses: in law, persons who by reason of their knowledge or skill of some art or science are qualified and admitted to examine, estimate, and ascertain certain things or matters in question, and testify of their opinions respecting the same. They are sharply distinguished from ordinary witnesses, who can testify only as to actual facts personally known to them. See EXPERT TESTIMONY.

F. STURGES ALLEN.

Exposition, Cotton-States and International: an exposition held in Atlanta, Ga., Sept. 18 to Dec. 31, 1895.

Origin.—Owing to the fact that certain Southern Legislatures were prohibited by their State Constitutions from making full exhibits at the World's Fair held in Chicago in 1893, a feeling arose in the South, after the close of the Columbian Exposition, that its great agricultural, mineral, and manufacturing resources had not been adequately presented to the world. The agitation of this fact, together with the desire to foster the trade relations already existing between the Southern States and the republics of Mexico and Central and South America, led Col. W. A. Hemphill, the business manager of the *Atlanta Constitution*, to decide that Atlanta, Ga., was the proper place to hold an exposition that should have for its chief purpose the exhibition of the products of the Southern States. The manager of the *Atlanta Evening Journal* was taken into consultation, and promptly through the medium of these journals the idea was presented to the public. The proposition was favorably received by the citizens of Atlanta. An exposition company was organized, and a directory consisting of fifty of the most enterprising and influential business men was formed. A popular subscription of $225,000 was raised among the citizens of Atlanta; the City Council of Atlanta appropriated $75,000; and Fulton County promised convict labor to the amount of $50,000. The U. S. Government appropriated $200,000 for a Government building and authorized an exhibit.

Officers of the Fair.—President and director-general, Charles A. Collier; first vice-president, W. A. Hemphill; second vice-president, H. H. Cabiniss; third vice-president, W. D. Grant; assistant to the president, Edmund A. Felder; treasurer, A. L. Kontz; secretary, J. R. Lewis; chief of publicity and promotion, W. G. Cooper; chief of construction, Grant Wilkins; chief of admissions and concessions, Edmund A. Felder; chief of art department, Horace Bradley; chief of educational department, W. J. Northen; chief of machinery department, J. H. Allen; chief of electricity department, H. M. Atkinson; chief of jury of rewards, Daniel C. Gilman; chief of public comfort, Alexander W. Smith; chief of transportation, E. L. Tyler; auditor, E. McCandless; general counsel, J. J. Spalding.

Location.—The site chosen for the exposition was Piedmont Park, which is about two miles from the center of the city. The natural picturesque features of the landscape were developed, and more than $300,000 was expended on that work. Large inland lakes were constructed, thus affording a water-frontage to many of the buildings.

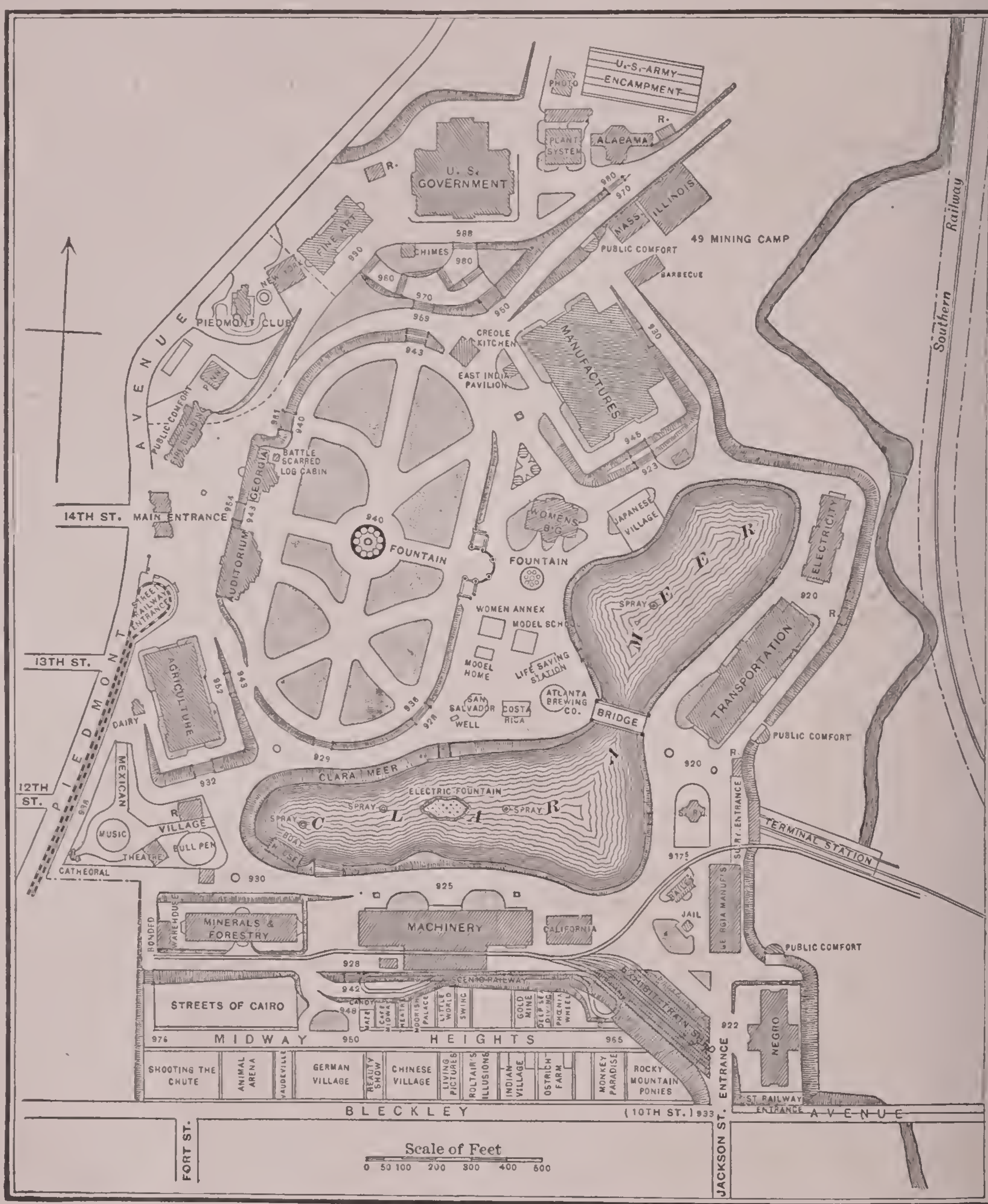
Buildings.—Thirty structures were erected on the grounds, most of them under the direction of Bradford L. Gilbert, of New York, and the prevalent type of architecture was the Romanesque. Among the most important were the following:

Administration Building.—The design for this building was a composite of the old baronial castles. The principal entrance was reached under a portcullis, and guarded, as in the days of the warlike barons, by the teeth of a huge iron-spiked gateway. The main tower suggested Rheinstein, an old Prussian stronghold on the Rhine. The entrance archway, frowning down with its deeply imbedded windows and loopholes, was entered by a circular doorway hewn from rough stones, and was a model of the old door of the Bloody Tower, part of the famous Tower of London.

Agricultural Building.—This structure was 300 feet long and 150 feet wide, and was one of the largest on the grounds. It covered an area of 44,000 feet, and the height of the central dome was more than 100 feet. The fullest possible display of the products of the Southern fields was shown within its walls.

Auditorium Building.—This occupied a lofty point on the grounds, and had a seating capacity of more than 3,000. Its acoustic properties were scientifically accurate, and the building was large, commodious, and airy. The music platform stood at the east end of the building, and along the sides cafés opened into the main hall so arranged that persons at the tables had a full view of the musicians.

Electricity Building.—Covering an area of 19,500 sq. feet, and 250 feet long by 91 feet broad, this building was on a commanding site. Its exterior was designed with particular reference to the effects to be gained by the use of numerous electric lights. The general outlines of all the buildings on festival nights were illuminated with incandescent lights of various colors.



Plan of the Exposition grounds.

MANUFACTURES BUILDING.

ADMINISTRATION BUILDING.

GENERAL VIEW OF THE EXPOSITION.

Fine Arts Building.—This structure was designed by Walter T. Downing, of Atlanta, and was 245 feet long by 100 feet wide. The central part of the front façade was 50 feet high, and the two side wings 26 feet high. Ample wall-space was given to the handsome collection of paintings, and many of the historic mansions and public buildings of the South loaned their treasures.

Manufacturers and Liberal Arts Building.—This was the largest and most important of all the buildings. It covered 103,000 sq. feet, and was 370 feet long and 216 feet wide. The main building was carried to a height of 90 feet, and was flanked on each corner by a tower nearly 60 feet square. One of the towers was carried higher than the rest and contained a magnificent chime of bells. Operating plants of every industry even remotely affecting the development of the South and its commerce were displayed within its walls.

Machinery Building.—This structure was 500 feet long and 100 feet wide, and covered an area of 96,500 sq. feet. Its entire basement was devoted to the placing of shafts and undershafts. It contained the latest and best inventions pertaining to the entire industrial field, including foreign as well as American products.

Minerals and Forestry Building.—This building was 220 feet long and 80 feet wide, was of natural woods, and included all varieties of foliage found in the South. The interior was festooned at the ceiling-line with Southern moss and evergreens. The spaces between the principal posts and braces covered an area of 26,000 sq. feet. A roof garden of the same area was provided, the sides of which were of palms and palmettos.

Negro Building.—The length of this building was 300 feet and it was 100 feet wide. For the first time in the history of the African race in the U. S. an opportunity was afforded it of exhibiting its progress under circumstances of enlightenment and freedom. The exhibit contrasted the condition of the race in Africa and the advancement of the Southern Negro.

Transportation Building.—An area of 55,000 sq. feet, included within the dimensions of a structure 413 feet long by 126 feet wide, constituted the space devoted to transportation. The war engines of the Western and Atlanta Railroad, every one of which had a history, formed a unique part of the exhibit. The progress within the last twenty-five years in the South was clearly shown.

U. S. Government Building.—An appropriation of $200,000 made by the general Government resulted in a structure covering 14,000 sq. feet, in which the Government exhibits were finely displayed. Exhibits from the Agricultural Department, the Interior Department, the Navy Department, the Smithsonian Institution, the War Department, and the State Department were shown.

Woman's Building.—This beautiful building, designed by Miss Elise Mercur, housed the exhibits that were peculiarly feminine, women being allowed to compete with men in all the general departments. It contained a nursery, cooking-school, resting-rooms, art-rooms, needlework-rooms, etc., and the offices of the Women's Board. An interesting exhibit was made by the women's patriotic societies.

Amusement Features.—The terraces between Piedmont Avenue and Jackson Street were devoted to amusement features. A street curved along the slope with a continuous succession of picturesque structures, the adobe houses and bamboo huts of the Mexican and Guatemalan villages and the wigwams of the Indians being in striking contrast with the antique designs of the Oriental village and the quaint or curious architecture of the Japanese, the Eskimo, the German, and Chinese villages. Other structures included Hagenbeck's arena of trained wild animals and his monkey-house. The Vaudeville theater, the Palace of Illusion, the Mystic Maze, and the Scenic Railway afforded much amusement, as did also Buffalo Bill's Wild West show. The villages were among the best features, and were occupied by real people of the countries typified. In the Mexican village some interesting archæological remains from the ruins of Palenque were exhibited.

Opening Exercises.—The formal opening of the exposition occurred on Sept. 18. A procession consisting of twenty-five military companies with five bands entered the grounds and marched to the Auditorium, where a programme was given that included a "Salute to Atlanta," composed for the occasion by Victor Herbert and rendered by his band; a prayer by Bishop Cleveland K. Nelson; an ode written by Frank L. Stanton and read by Col. Albert Howell; an opening address by Charles A. Collier, the president of the exposition; an address by Mrs. John Thompson, representing the Woman's Department; an address by Booker T. Washington, representing the Negro Department; and an address by Mayor Porter King, representing the city of Atlanta. On the conclusion of these exercises the engine in Machinery Hall was set in motion by an electric button that was pressed by President Cleveland in his cottage in Gray Gables, Mass.

Exhibits.—Special State exhibits were made by Alabama, Arkansas, California, Connecticut, Florida, Georgia, Illinois, Louisiana, Massachusetts, Mississippi, New York, North Carolina, Pennsylvania, South Carolina, Tennessee, and the District of Columbia, and special buildings were erected by Alabama, California, Georgia, Illinois, Massachusetts, New York, and Pennsylvania. Exhibits were sent also by the Governments of Austria, Belgium, Germany, Great Britain, Italy, Mexico, and Russia, and by several of the South American and Central American republics.

Expenses and Results.—According to the report of the auditor the total cost of the exposition was $960,930.20, distributed as follows: Administration, $63,562.64; grounds and buildings, $442,789.11; publicity and promotion, $41,004.20; woman, $3,280.77; privileges and concessions, $25,827.60; foreign, $5,696.81; machinery and electricity, $215,334.38; mines, $4,670.67; forestry, $3,078.87; fine arts, $13,814.80; Negro, $6,130.82; public comfort, $5,908.15; public comfort bonus, $20,090; exhibit, $18,244.48; admission, $27,259.58; and amusements, $64,236.69. Of these amounts it is estimated that 10 per cent. was expended for promotion, 60 per cent. for construction, and 30 per cent. for operation. The total number of exhibits was 3,619, which came from 37 States and 14 foreign countries. The receipts from the floor-space amounted to $79,000; from concessions, $125,230.58; from admissions, nearly $500,000. The total attendance was 1,179,889. MARCUS BENJAMIN.

Exposition, Pan-American: From May 1 to Nov. 1, 1901, an exposition was held at Buffalo, N. Y., to celebrate the achievements of the western hemisphere during one hundred years, and to promote trade between American countries. The site occupied 350 acres, there were twenty large buildings, and the cost of preparation was about $10,000,000, of which $500,000 was appropriated by the U. S. Government.

Expositions, Permanent: Within the last decade a number of museums have been opened in various countries whose special purpose is to promote commercial interests. The Philadelphia commercial museum, supported by the city and by fees from subscribers, who receive its regular or special reports, is perhaps the best developed of this class of permanent exhibitions, and a brief description of it will show the means they employ to further commercial education. Its spacious quarters are filled with exhibits arranged by countries showing the foreign goods exported to lands where U. S. goods meet them in competition. For instance, the products of Mexico are shown, and also the goods that are made in Europe and sold in Mexico. If a Connecticut cutlery-maker wishes to extend his trade to Australia, he may learn at the museum the quality, shape, and prices of the sheep-shears and all other varieties of cutlery that are sold in the Australian markets. It is also a function of the museum to supply the latest information as to the nature of commodities, tariffs, and local demands and conditions in all countries. This museum is in correspondence with more than 30,000 business houses in the U. S., and with about 20,000 in foreign countries. The commercial museum at Brussels contains only manufactured articles made in other lands, and brought together so that home manufacturers, by studying them, may compete more intelligently in foreign markets. The museum was so successful that others were started in other cities of Belgium. It is a part of the duty of Belgian consular agents throughout the world to send for distribution among these museums specimens of every article imported or manufactured and on successful sale in the countries where they are serving. Stimulated by the success of the Belgian museums, France has established fifteen of these institutions in her principal manufacturing and commercial centers, and they are regarded as most successful. Other commercial museums, some of them supported by private enterprise, and others, to a greater or less extent, by governments, have been established in Vienna, Berlin, Stuttgart, Berne, Milan, and Rome. The Japanese Government, also, has opened a commercial museum at Osaka to afford a central place for the exhibition of native and foreign products. In order to familiarize other countries with U. S. products, the National Association of Manufacturers has undertaken to establish what it calls American sample warehouses at various foreign centers. The first sample warehouse was opened at Caracas, Venezuela, on Apr. 18, 1898, with a great variety of exhibits representing sixty-one U. S. manufacturing industries. and the association has been investigating the conditions at Buenos Ayres, Hamburg, and Kobe, Japan, with a view to establishing sample warehouses at those places. C. C. ADAMS.

Ezekiel, MOSES JACOB: sculptor; b. in Richmond, Va., Oct. 28, 1844. After service in the Confederate army, he graduated at the Virginia Military Institute in 1866; studied anatomy in the Medical College of Virginia; removed to Cincinnati in 1868; visited Berlin, Germany, in 1869, where he was admitted into the Society of Artists on the merits of his colossal bust of Washington, and where he was the first foreigner to win the Michael Beer prize. The Jewish order of the Sons of the Covenant commissioned him, in 1874, to execute a group representing *Religious Liberty*, for the Centennial exhibition; the work was unveiled in Fairmount Park, where it remains. He made statues for the outside niches of the Corcoran Art Gallery in Washington. After 1886 his work became chiefly ideal. Among his productions are busts of Liszt and Cardinal Hohenlohe; *Industry*, a statuette; reliefs of Schiller and Goethe; bas-relief portraits of Farragut and Robert E. Lee; *Pan and Amor*; *The Fountain of Neptune*; and *Art and Nature*. He also made a bronze medallion of W. W. Corcoran for the gallery in Washington.

Fairlamb, JAMES REMINGTON: musician; b. in Philadelphia, Jan. 23, 1837; studied at home, and was organist of several churches before he was twenty years old. In 1858 he went to Europe for study, returning in 1860, but in 1861 was appointed U. S. consul at Zurich. He returned again in 1865, and was successively organist of several churches in Washington, Philadelphia, and New York. His compositions include much church music, many songs, and two operas, *Valerie* and *Leonello*. D. E. HERVEY.

Fajardo, fāā-chaar'dō: a port on the E. coast of Puerto Rico, about a mile from the fine bay which gives it importance. Founded in 1774. Muscovado-sugar making is the chief industry of the district, and sugar, molasses, and tortoise-shell are the chief exports. Imports from the U. S. are mostly lumber, provisions, and hickory barrel-hoops. The town is connected with the interior by excellent roads. Pop. (1887) 8,779. C. C. A.

Falconer, JOHN M.: artist; b. in Edinburgh, Scotland, May 22, 1820. He removed to the U. S. at the age of sixteen; studied art in the National Academy of Design, with the Society of Painters in Water-colors in New York city, in the Graham Art School and with the Art Association of Brooklyn, and in the Louvre in Paris. The first exhibition of engravings in the U. S., held in Brooklyn in 1864, was proposed by him; he organized the first chronological exhibition of American art, held in Brooklyn in 1872, and the first exhibition of water-colors by the Artists' Fund Society of New York, the parent of the existing American Water-color Society. He painted in oil *Kenilworth Castle*, *The House where the Declaration of Independence was Written*, and numerous other subjects; in water-colors he produced many historic houses. He wrote a *Sketch of the History of Water-color Painting*, and compiled the *Catalogue Raisonnée of the Chronological Exhibition of American Art*.

Fanciulli, FRANCESCO: bandmaster; b. in Port St. Stephen, Tuscany, in 1853, and educated in Florence, where he afterward conducted grand opera. Settling in the U. S. in 1876, he occupied himself as teacher and organist, composing much all the time. He succeeded Sousa as conductor of the Marine Band at Washington, D. C., but left that position to take charge, on Jan. 1, 1898, of the band of the Seventy-first Regiment, New York State Militia, succeeding Felix Erben. D. E. HERVEY.

Fanning Islands: In the Pacific Ocean, on both sides of the equator, a considerable number of small islands are strewn between 150° and 180° W. lon., and from 11° N. to 5° S. lat. A number of them have been guano-producing islands, and as the trade was carried on chiefly by Americans they were for some time known as the America islands, but have since been better known as the eastern part of the Central Polynesian group, or the Fanning islands, from the name of one of the largest among them. They are mostly coral reefs, with or without lagoons, flat and low, and the existence of some of them is still in doubt, as is shown by the mark (?) placed after their names on many maps. The two most important of the Fanning islands are Christmas and Fanning islands. Christmas island is far the larger of the two, and the reef incloses a lagoon of unusual size in that part of the Pacific. The island has been the occasion of a number of shipwrecks, vessels running unawares upon the low-lying reef. No fresh water is obtainable, and Fanning island, with its fruitful soil, rich vegetation, many palms, and potable water, is far more attractive. The two islands, together with Malden and Starbuck islands, have been British possessions since 1888, and the area of all the Fanning islands, including their lagoons, is estimated at 260 sq. miles. For a long time the output of guano from the Fanning and other islands of the Central Polynesian group was about $250,000 a year, but the supply is now practically exhausted. C. C. ADAMS.

Farm Laws, or **Agricultural Laws**: a general term used in law to include agricultural customs and all those laws affecting landlords and tenants of farms, many of the homestead laws, and laws affecting the interests of those engaged in the cultivation of the soil. When spoken of in general, a *farm* is understood to mean any considerable tract of land set apart for cultivation by a single occupant or under single control, whether by the owner or by the tenant; and the term is also frequently used to include several separate tracts cultivated together by one person or under one control. The laws of chief interest as relating to farms and farming are those affecting the rights of tenant and landlord, or those affecting the owners of interests for life or for a term of years in farms. The most important of these are the rights as to agricultural erections or buildings, fences, crops or emblements, manure, fruits, irrigation, mines and minerals, game, overhanging trees, repairs, stock or domestic animals.

In England it has been held that the existence of the mere relation of landlord and tenant is a sufficient consideration for an implied or an express promise on the tenant's part to manage the farm in a good and husbandlike manner, and not to carry away any straw, dung, etc.; but in the absence of custom or special agreement a tenant may carry away straw or hay from the premises. A change in the course of husbandry, or the pulling down of houses, or the opening of new mines or pits, would constitute waste.

Agricultural Erections.—The tenant of a farm has a right to take wood from the land for agricultural erections, including fences and necessary improvements; but in so doing he may not destroy ornamental trees or fruit-trees belonging to an orchard or a garden. He may also cut firewood, but not to sell, provided there is not sufficient dead wood on the premises for his consumption. These rights as to the cutting of wood are broadly governed—not only by the local custom, but by general rules varying in application with the circumstances of each case.

Crops.—The tenant's right to crops at the time of his incoming or outgoing is governed by the law of emblements, he not being entitled to the crops left by the tenant preceding him, and being entitled to those which he leaves at his outgoing. See EMBLEMENTS.

Manure.—The ownership of the manure made upon a farm in the ordinary manner from the consumption of the products of the farm is, in the U. S., generally held to belong to the owner of the farm, and passes with the farm if the latter be sold, upon the general theory that it is for the interest of good husbandry and of agriculture that the manure produced on a farm should be consumed on it. In Great Britain manure made on a farm is assignable by the tenant, but by assigning it the tenant becomes subject to an action for bad husbandry. In England there is also a usage for a landlord to pay a certain sum in compensation to the outgoing tenant, as well for the labor and expense bestowed by him for tilling the fallow land as for manuring the meadow-land, according to the course of good husbandry, the advantage of which manuring the tenant could not otherwise reap. Such a custom is a mere usage of the neighborhood, and is not a custom strictly speaking, and need not be immemorial. The owner of the farm may treat the manure so as to make it personalty, so that it will not pass with the farm if sold, as by heaping it up, or in some other distinct manner showing its separation from the farm.

Fruit.—The fruit growing on a farm belongs to the realty until it has been actually gathered, thus being distinguished from the emblements or crops raised only by cultivation—such as corn, wheat, potatoes, etc. The picking by an outgoing tenant of fruit which shall not have become sufficiently ripe to be suitable for gathering before the expiration of his occupancy constitutes waste. See WASTE.

Irrigation.—The right of an owner of a farm to the irrigation of his land so as to draw water from streams running through the land of others besides his own, or so as to discharge water over the land of another, is regulated by the rights of riparian owners and the right of drainage. In general, the tenant or owner of a farm the land of which borders on a natural stream of water has the right to use the water for any reasonable purpose not inconsistent with the similar rights of owners of the land above or below or opposite to his land; but where the use of the water of such a stream for the purpose of irrigation would so diminish the supply of water as to deprive the different proprietors living along the stream of their proper use of the water none of the owners adjoining on the stream may use it for irrigation. For domestic purposes, however, and for watering stock, any one of them would be justified in consuming all the water flowing through his premises. Where the irrigation of the premises involves the discharge of waters on the surface of another's land the tenant has the right to irrigate, provided the discharge does not create a new channel or watercourse over the land of the owners above or below him, and does not overflow the land of the adjacent owners beyond the natural limit of the water flowing over the land. Where two fields or farms are adjacent, and one is lower than the other, the owner of them has the general right to have the water that falls or flows upon his land flow off from the same upon the land below by the natural system of drainage. For such purposes the water is roughly distinguished into surface water and that which is not surface water, surface water being that which falls upon the surface of the land, but is not gathered into streams or ponds or lakes. The owner of a farm has no right to alter the natural flow of the water upon another's land; nor may he make any excavations or trenches by which the water is diverted from its natural channel, or direct it in a new channel made over his neighbor's land. He may not unite waters flowing in several channels so as to discharge them in an unnatural amount in a single channel upon the lower lands of his adjacent owners. The owner of a farm may make such excavations for wells on his own land as he sees fit, provided he does not encroach upon the territory of his neighbors, even though the result of the use of his wells should be to draw the subterranean water from his neighbors' wells and dry them up.

The right of irrigation by the tenant or owner of a farm is subject to similar rights of other riparian proprietors; and a non-user of similar rights by others, whether above or below, will not raise the presumption of a grant, or divest such owner of his right to the use of the stream for similar purposes. In irrigation the entire body of water may be diverted from its channel, provided it be again restored before leaving the premises of the tenant or owner. Where, however, there is an undue detention of water, it is not necessary to show actual damage, but the law will infer damage and remedy the wrong.

Mines and Minerals.—The tenant may continue the working of pits or mines which are open before the tenant enters into possession, in the absence of an express agreement, and dig or use them for his own benefit without incurring waste. The opening of new mines or pits, in the absence of an agreement permitting it, would constitute waste. See WASTE.

Game.—The matter of the killing and taking of game is generally regulated by the game laws. The ownership of game, however, vests absolutely in the owner of the premises on whose land they are found, being thus distinguished from domestic animals. See FERÆ NATURÆ.

Overhanging Trees.—Trees growing near a boundary line so that the roots extend and grow into the land of the adjacent owner and derive nourishment from it remain the sole property of the owner of the land on whose premises the trunk remains, even though some of its branches overhang the land of his neighbor, and the owner of the tree is entitled to all of its fruits. For the purpose of gathering the fruits he may reach over and pick them, and he has an action for assault if he is prevented from so doing by others. If, however, the fruit falls upon the neighbor's land, the question of the ownership is not settled. The owner of the adjacent premises over whose land the branches of the tree hang may, however, cut off the overhanging branches or the roots growing into his premises, but may not keep them or use them for his own purposes without being liable for their value.

Where a tree stands on the boundary line so that the trunk of the tree extends into the land of the owners of each of two adjacent fields, the tree and the fruit are owned in common, and neither may cut away the tree or any part of it so as to injure the common property. If the overhanging tree be poisonous, however, and poison or injure the cattle of the owner of the premises overhung by its branches, the owner of the tree is responsible for damages; but he is not responsible if the cattle break through to the poisonous tree which is reasonably removed from the boundary line. The having of poisonous trees on the premises, or allowing them to grow there, is regulated by the same general law of negligence which governs the placing of dangerous traps or pitfalls where they are likely to injure another.

Repairs.—In the absence of an express agreement between the landlord and tenant, the tenant is under obligation to make tenantable repairs—such as keeping the house tight against wind and water, repairing doors and windows broken by him, etc.; but he is not under obligation to make lasting or substantial repairs. That is, he is not obliged to repair the buildings damaged or injured by the natural wear and tear arising from reasonable use and the action of the elements.

The occupant of the premises is also bound to keep the fences in repair, and is entitled to such use and occupation of the premises of adjoining owners as is necessary to carry out his duty. The tenant is not under obligation, however, to repair the outbuildings and other erections on the farm, except when bound so to do by special agreement. The liability of the tenant for his rent is not affected by the property becoming untenantable for want of repairs, or by its destruction from any cause in the absence of an express provision, excepting damage from fire, storm, or unavoidable contingency; and the tenant can not compel the landlord to expend insurance money in rebuilding burned or destroyed buildings.

If the fences are allowed by the tenant to become out of repair to the damage or injury of another, in general, at the common law, the tenant or occupier is responsible alone in an action for damages. The tenant of a farm is not obliged, at the common law, to erect fences between the land occupied by him and that of an adjoining owner to prevent trespass upon his own land of cattle or domestic animals of any kind from the land of the adjoining owners, but must erect and keep fences to prevent trespass by his own cattle and domestic animals. See FENCES and TRESPASS.

Domestic Animals.—Domestic animals, as distinguished from wild animals, or *feræ naturæ*, constitute property, and are the subject of ownership. The owner of them is bound to use reasonable diligence in the care and guarding of them, and is liable for such trespass or damage done by them when not rightfully in the place where they may be. In general, the owner of ordinary domestic animals which are not likely to do mischief—such as sheep, oxen, horses, etc.—is not liable for injuries done by them to a person or property of another if they are lawfully in the place where the injury is done, unless it is shown that the particular animal was accustomed or inclined to do mischief, to the knowledge of the owner. But when the owner keeps an animal which is accustomed to bite mankind, or is accustomed to do other injury to the person or property of others, with knowledge that it is so accustomed, he is *prima facie* liable for damages to the person injured by the animal for negligence in the care of the animal. See DOMESTIC ANIMALS, FERÆ NATURÆ, and NEGLIGENCE.

F. STURGES ALLEN.

Fâsher, El: the capital of Darfur, a province of the Egyptian Sudan, lying near the foot of the Djebel Wanda at a height of 2,400 feet. It is the meeting-place of caravan routes from all points, and before the Mahdist revolt was the center of the considerable trade in gums, ivory, hides, ostrich-feathers, coffee, glassware, cotton cloth, guns, etc., passing between the states of the Central Sudan, Khartum, and Egypt. A wady descending from the hills to the northwest supplies the water required, and this and the consequent verdure of the surroundings and the little lake on which the town fronts are the chief advantages of the site. The town

is poorly built of clay and thatched straw huts, and is supposed to have a population of about 3,000. Kobeh, about 30 miles to the N. W., is a larger place, contains some stone buildings owned by traders, and is the starting-point of the desert caravan route N. E. to Assiut, forty days' journey.
C. C. ADAMS.

Fashoda: a town on the White Nile, in the country of the large Shilluk tribe, about 400 miles S. of Omdurman. It was founded by the Egyptian Government in 1867 and for a number of years was the southern limit of its territories in the Sudan, and was the base from which the Shilluk country was subjected to Egyptian rule. A fort was built at this strategic point, and Fashoda was long a place of imprisonment for Egyptian prisoners condemned to perpetual exile. It occupies a low-lying, unhealthful site, and is the southern limit of wheat cultivation in the Egyptian Sudan. When Omdurman fell into the hands of the Anglo-Egyptian forces, in Sept., 1898, Fashoda was held by a French force under command of Capt. Marchand, who had descended the Nile, and claimed Fashoda and the country S. of it as a French possession. After some months of negotiations, France consented to evacuate Fashoda and to relinquish all claims to territory on the Upper Nile. An arrangement was reached in Mar., 1899, by which Great Britain, on her part, agreed to concede to France ample commercial facilities on the Upper Nile, and the extension of the French sphere of influence in the Central Sudan several hundred miles farther N., so as to include the whole of Wadai and its vassal states, Baghirmi and Kanem, and the populated and mountainous districts of Tibesti, Borku, and contiguous oases in the desert of Sahara. This act practically completed the partition of the continent, excepting the independent African states and the Libyan Desert, among the European powers. The railroad up the Nile to Omdurman, which was completed in 1899, is to be extended to Fashoda.
C. C. ADAMS.

Fassett, CORNELIA ADÈLE (*Strong*): artist; b. in Owasco, N. Y., Nov. 9, 1831. She studied in New York city, in Paris, and in Rome; painted portraits in Chicago, and in 1875 removed to Washington city, where, besides executing portraits of many noted statesmen, including Chief Justice Waite, Justices Miller and Field, President Garfield, and John A. Logan, she painted *The Electoral Commission in Open Session*, containing portraits of about 200 persons. D. in Washington, D. C., Jan. 4, 1898.

Fastnet Rock Light: a light at the entrance to Long Island Bay, on the southwest coast of Ireland; the first light sighted on the Irish coast by vessels crossing the Atlantic from New York to Liverpool. The light is 148 feet above sea-level and is visible for 18 miles. The arrival of many east-bound steamships across the Atlantic is first reported from Fastnet.

Fauque de Jonquières, fōk'de-zhōn'kĕe-ār', JEAN PHILIPPE ERNEST, de: admiral and mathematician; b. at Carpentras, in the department of Vaucluse, France, July 3, 1820; entered the navy in 1835, and became a captain in 1858, and an admiral in 1874; grand officer of the Legion of Honor 1881. He was elected member of the Academy of Sciences Mar. 24, 1884. He held important commands in Cochin China (1864) and as maritime prefect of Rochefort, and published several valuable mathematical treatises, including *Mélanges de géométrie pure* (1856); *Théorèmes fondamentaux* (1865); *Système de courbes et surfaces algébriques d'ordre quelconque* (1866).

Faure, JEAN BAPTISTE: singer and composer; b. in Moulins, France, Jan. 15, 1830, and studied at the conservatory in Paris; won first prize for singing in 1852, and also for opera comique. He made his début at the Opera Comique, Oct. 20, 1852, and subsequently sang in London and Berlin, taking the leading barytone rôles in many operas. He was also, for a time, in 1857, Professor of Singing in the Paris Conservatory, and in 1874 in Brussels. He has composed much for the voice, and also for the piano. His most famous songs are *Les Rameaux* (The Palms) and *Crucifix*.
D. E. HERVEY.

Fausset, ANDREW ROBERT, D. D.: clergyman; b. in Silverhill, County Fermanagh, Ireland, Oct. 13, 1821; graduated B. A. at Trinity College, Dublin, 1843; has been since 1859 rector of St. Cuthbert's, York, England. He is a prolific author of scholarly religious literature, and among his works may be mentioned his part in the well-known Jamieson, Fausset, and Brown's *Critical, Experimental, and Practical Commentary* (Glasgow, 1868), and independently *Horæ Psalmicæ* (London, 1877, 3d ed. 1885); *The Englishman's Bible Cyclopædia* (1879, 4th ed. 1893).
S. M. J.

Fay, AMY: pianist and teacher; b. in Bayou Goula, La., May 21, 1844. Showing decided musical talent in early years, she was sent to Europe for further study. She remained there several years, studying under well-known teachers. She has written a book entitled *Music Study in Germany*, giving her experiences while studying. She has devoted her life to playing the piano and teaching, giving musical lectures and *conversaziones*, and is much identified with women's musical clubs and the advancement of women in music generally. Her brother, Norman Fay, is an officer of a bank in Chicago, and her younger sister, Rose, is the wife of Theodore Thomas. Their father was the Rev. Dr. Charles Fay, an Episcopal clergyman, who died Nov. 6, 1888, and her mother was the daughter of Bishop John Henry Hopkins, of Vermont.
D. E. HERVEY.

Fay, THEODORE SEDGWICK: author; b. in New York city, Feb. 10, 1807. After studying law, he became associate editor of the New York *Mirror*, with George P. Morris and Nathaniel P. Willis, for which paper he wrote a series of letters of European travel; was secretary of the American legation in Berlin 1837–53; was minister resident in Berne, Switzerland, 1853–61, after which he lived in retirement in Berlin. His published works comprise *Dreams and Reveries of a Quiet Man* (1832); *The Minute-book* (1833); *Norman Leslie* (1835); *Sydney Clifton* (1839); *Countess Ida* (1840); *Hoboken, a Romance* (1843); *Robert Rueful* (1844); *Ulric, or the Voices*, poems (1851); *Views of Christianity* (1856); *History of Switzerland* (1860); *Great Outlines of Geography* (1867); *History of Germany* (1888); *and Forty Dollars and the Boots, or Shall we not Abolish our Apostles' Creed?* (1897). D. Nov. 17, 1898.

Febiger, JOHN CARSON: naval officer; b. in Pittsburg, Pa., Feb. 14, 1821; entered the navy as a midshipman Sept. 14, 1838; became a passed midshipman in 1844, lieutenant in 1853, commander in 1862, and captain in 1868. From 1861 to 1863 he commanded various vessels of the Western Gulf and Mississippi squadrons, and in 1864–65 commanded the Mattabeset (North Atlantic blockading squadron), in which vessel he participated in the desperate fight between the little squadron of wooden vessels under the command of Capt. Melanchthon Smith and the ram Albemarle, which took place in Albemarle Sound, N. C., on May 5, 1864, and resulted in the defeat of the ram and the capture of her tender, the Bombshell. For his gallantry and skill on this occasion Febiger was warmly commended by Capt. Smith and Rear-Admiral Samuel Phillips Lee. He was inspector of naval reserve lands 1869–72, was made commodore Aug. 9, 1874, was a member of the board of examiners 1874–76, and commandant of the Washington navy-yard 1876–80. He was made rear-admiral Feb. 4, 1882, and retired July 1, 1882. D. in Londonderry, Md., Oct. 10, 1898.

Fee: in general, any reward or compensation for services; but mainly used in law for (*a*) the remuneration fixed by law for the services of public officers, or (*b*) the reward received or due for professional services, as by a lawyer. In Scotland the term is also commonly used as the equivalent of wages, especially the wages of servants.

Fees are in general distinguished from *salaries* by being remuneration for specific services rendered by a special or general agent; salaries being wages received by persons in the general employ of another at a rate or amount agreed upon per day, week, or otherwise. Formerly most government officers whose duties were ministerial and related to the active administration of the machinery of government, such as officers of court, customs officers, etc., received their remuneration for services given by fees, the amount being fixed by law at a percentage or at a given amount for each particular act or service rendered; and this system of remuneration, in many cases, was applied even to the judges of the lower courts, especially justices of the peace. This method of fixing the remuneration of public officers by fees is gradually giving way to that of employing officers to perform their duties at a fixed salary, based partially on the value of the services rendered, and often partially on the fees received in the office held by the incumbent, it having been found in many cases that the income received by the incumbent in office from fees was greatly out of proportion to the value of the services rendered, and also that the existence of the right of demanding fees was productive of extortion in office.

Fees of Public Officers.—For the specific fees paid to officers in any jurisdiction or government, municipal, State, or federal, in the U. S., or under any other government, the statutes regulating the same must be consulted ; or when they are regulated by custom, the decisions of courts or local records or treatises thereon.

Fees of Lawyers.—The laws affecting the payment of fees for professional services in the U. S. differ very widely in many respects from those in Great Britain. In the U. S. the fees of attorneys and counselors at law are, almost without exception, left to be settled by mutual agreement between the parties ; or, if this can not be done, are fixed by awarding to the attorney such amount as is adjudged to be a reasonable payment for the services rendered. In deciding what is such an amount the questions of the degree of responsibility assumed by the attorney and of the amount involved in the transaction concerning which the services took place frequently play a very important part, and it often happens that for services otherwise the same widely different sums are paid and recognized as being proper. The attorney does not need to stipulate what his fee shall be, but on rendering the services he may present a bill for such amount as in his judgment seems proper, which may or may not be paid voluntarily, as the case may be. The amount of his fee may be fixed by mutual agreement at any time at any sum which the parties see fit, and may be, generally speaking, a gross sum or a percentage of the amount involved in the transaction, the amount recovered in the judgment, or the like ; and in respect to fees, no distinction is made between services rendered in litigated actions, drawing of papers, conveyancing, etc.

In Great Britain the fees of solicitors, conveyancers, etc., are regulated by statute, prescribing the amount that may be charged for each specific act in the preparation of actions, filing of papers, writing of laws, drafting of copies, settlement of estates, abstract of title, attending references, drawing of leases, etc. The Supreme Court Judicature Act of 1873, and the additional rules of 1875 and subsequent years, made minute regulations governing these fees, but the act of 1881, commonly known as Solicitor's Remuneration Act (44–45 Vict., c. 44), was the first act that attempted in a definite way to place the charges of solicitors on an *ad valorem* basis. This act does not extend to Scotland, but the fees of the corresponding attorneys (there generally called *law agents*) were also regulated by statute (A. S. July 15, 1876, A. S. Dec. 4, 1878, and acts amendatory thereof).

The fees of counsel in Great Britain are upon an entirely different basis from that obtaining in the U. S. A counselor is not at liberty to decline, except in very special instances, to act for any party who applies to him for his advice and aid in litigation, but is bound in any case that comes into court to take the retainer of the party who first applies to him, whatever be the amount of the retainer offered. He can not demand or recover by action any reward for his services, but receives pay for them entirely in what is voluntarily given him by his client (the *honorarium* of the civil law), he, on the other hand, not being liable for negligence in the conduct of the case, and being free to act unrestricted even by the express instructions of his client. The *fees* of counsel in Great Britain are very carefully and rigidly distinguished from *gifts*, counsel not being allowed to receive gifts from his client during the continuance of the relationship of clientage. The same rule is generally applied in the U. S., but not so strictly, the theory being that gifts made during the continuance of such a relationship are subject to suspicion of undue influence.

The British system of fees according to unvarying tariff of prices fixed by law has met with much criticism and opposition from the attorney and solicitor, because it enables the unscholarly and ignorant to demand and receive for services the same prices as those paid to scholarly and learned men for services nominally the same, but actually much more valuable ; and from solicitor and client alike, because the system places a premium on circumlocution, and the conducting and performance of a number of technical acts and proceedings by the distinguished practitioner for the sake of increasing the fees which can be charged a client in any particular action.

Fees of Witnesses.—These are fixed by statute or local custom, and are usually a reasonable mileage fee, and a remuneration in addition that is nominal, or nearly so, especially in criminal actions. Expert witnesses, except in public cases, usually receive such fees as they see fit to ask, as a condition of testifying. See EXPERT TESTIMONY. See local statutes and treatises, and Morris's *Solicitors' Fees and Court Fees* (London, 1876); Evans's *Solicitors' Remuneration Act* (London, 1883); *Observations on the Remuneration of Attorneys and Solicitors*, a pamphlet by Reginald A. Parker (London, 1853).

Physicians' Fees.—In Great Britain a physician can not recover his fees by an action at law, except for his attendance at the death-bed sickness, it being generally understood there that the fees of a physician, like those of a counsel at law, are honorary, and not demandable of right; and, except for the death-bed sickness, they are presumed to have been paid, unless otherwise expressly stated. In the U. S. a physician's fees may be sued for and recovered on a *quantum meruit*, as in the case of services rendered by any other person.

F. STURGES ALLEN.

Fences: In general legal usage the term *fence* is applied to any kind of structure making an inclosure or division, such as a hedge, ditch, bank, wall, or structure of rails; it is distinguished from a *boundary*, in that the latter word is particularly applied to the line of division between the contiguous estates of different owners, while a fence is any structure used in the separation of such estates or of the parts of one estate.

The nature of the fence which an owner is required to construct in order to throw the liability for trespass upon the other party is discretionary, so long as the fence be calculated under ordinary conditions to be reasonably efficient as a protection against trespass by domestic animals.

The law does not require fencing against such small animals as would pass through or under an ordinary fence, nor against such wild animals as would break through. Where the statutory law prescribes the height of the fence, no damage can be recovered for injury or trespass by animals without showing that the fence was of the required statutory height.

Who Must Maintain Fences.—At the common law, a person who keeps cattle or other domestic animals is responsible for damages done by their trespassing upon the land of another unless they are properly confined by a fence. This rule obtains in many of the States of the U. S., including Delaware, Indiana, Maryland, Massachusetts, Michigan, Minnesota, New Hampshire, New York, New Jersey, Vermont, Rhode Island, and Wisconsin, and also in the Dominion of Canada. In other States it is held that in the absence of statutory regulation the owner of cattle or other domestic animals is not obliged to confine them in an inclosure in order to avoid liability for their trespass upon land of another. This rule obtains in the States of Arkansas, California, Colorado, Florida, Georgia, Iowa, Kentucky, Mississippi, Missouri, North Carolina, Ohio, Oregon, Pennsylvania, South Carolina, Texas, Virginia, West Virginia, Montana, Washington, and some others.

Statutory Regulations.—The subject of the duty of building and maintaining fences is generally regulated by local laws. These generally provide that the owners of adjacent premises are required to bear equally the expense of the construction of the fence required by law, which may be constructed on the land of both as a partition fence. The fence is presumed to be the common property of both owners, and either of them may repair it, compelling the other to bear his portion of the expense, if necessary. Where the construction of the fence is not required by law either party erecting the fence must bear the entire expense of it, and construct it entirely on his own premises; but for the purposes of repairing it he has the privilege of going upon the adjacent land of the other owner, so far as is reasonably necessary for the purposes of repair.

Fences constructed in such a manner, or of such materials, as to be calculated to injure the cattle or other domestic animals of another generally render the person constructing the fence liable for damages so created.

A general distinction is made between the construction of *outside fences*, or those boundaries bordering upon public lands such as highways, and *division fences*, or those between the lands of adjacent owners. As to outside fences, the landowner may fence his property or not, as he chooses; but so long as he fails to inclose the land he can not recover damages for trespass of the domestic animals of others upon his property; but as to division fences he must bear his share of the expense and burden of construction and repair. The statutes regulating the subject of partition fences generally provide for the appointment of fenceviewers, town trustees, or other officers, who assign to each owner the portion of fence which he is to build and maintain, and, when necessary, appraise the value of fences erected or of repairs made. The rights of adjoining owners conferred by such statutes may be waived by them by agreeing upon something different; but such an agreement may be terminated by notice from either unless the agreement be such as to estop its termination.

Fences are Real Property.—A fence, in general, is a fixture and a part of the realty, and can not be replevied or levied upon as personal property. So, when the fence is built by one person on the land of another, but without any agreement between them, it becomes the property of the landowner, who may remove it and dispose of it at his pleasure. See FIXTURES.

Railroad Fences.—At the common law, a railroad company is governed by the same rules as any natural person; but statutes have been passed in Great Britain and in many of the States of the U. S. requiring railroad companies to fence their tracks, and holding them liable for all injuries caused by their failure to comply with the statutes, regardless of whether the company has been guilty of negligence or not. Such statutes are held to be constitutional and valid as part of the police power of the State. At those points where the tracks of a railroad company pass a public highway the cattle-guard takes the place of the fence; but, in the absence of statutes, there is no more obligation on the part of the railroad company to maintain these than to maintain fences along the division lines.

A railroad company which passes through and divides the property of a landowner with its line can not so inclose or fence its tracks as to shut off the passage from one piece or parcel of land to the other by the owner, but must provide a suitable gate, bars, or other means of access from one piece to the other. See Hunt's *The Law of Boundaries and Fences* (London, 1896); Thornton's *Railroad Fences and Private Crossings* (Indianapolis, 1892); *American and English Encyclopedia of Law*, vol. vii.; and local statutes and municipal laws. F. STURGES ALLEN.

Fen Country: the lowest-lying part of England, tributary to the large and shallow bay known as the Wash, and embracing an area of about 1,200 sq. miles, fronting on the middle east coast in the neighborhood of that bay. It is called the "Holland of England," and with propriety, for, though it lies above sea-level, the surface is so low and flat that much of the sea-front requires protection by walls. The natural drainage agencies are the Witham, Welland, Nen, and Ouse rivers, which are almost stagnant, with rather indefinite courses and changeable mouths, and meander through a region that once was neither good land nor open water. By extensive canalization and drainage much of the land has been reclaimed, and the river-courses have been regulated by embankments. Fishing is an important industry along the coast. C. C. ADAMS.

Ferghana: a province of Russian Central Asia, occupying the basin of the upper Syr-Daria (*Yaxartes* of the ancients), embracing 39,500 sq. miles, of which about 13 per cent. is capable of cultivation. It lies between 39° and 43° N. lat. and 70° and 75° E. lon. "Blooming Ferghana" (formerly *Khokand*) is one of the richest and most promising parts of Russian Central Asia. The cultivable land is in the valley of the Syr-Daria, and the rest is steppe or mountain land, for the most part treeless and desolate, and in many places useless even for grazing. The climate passes through all stages, from tropical in the valley of the Syr-Daria to Arctic cold on the heights of the Trans-Alai. The cultivated soil is loess and requires artificial irrigation, and where this is available agriculture flourishes. Wheat, rice, barley, vines, cotton, vegetables, and all the best fruits of Southern Europe thrive. American cotton has been planted with great success and is one of the most profitable crops. Industries are quite diversified and are constantly developing, and the population, about 1,000,000 in number, mostly Mohammedans, are persevering, work their fields in a model manner, build irrigation works, and develop vineyards and fruit and garden industries. Russian immigration is increasing. The most important towns are Khokand, 60,000 inhabitants; Andijan, 40,000; and Marghelan, 35,000. At present the transportation of freight from Ferghana to Samarcand is two and a half times as costly as from Samarcand to the Caspian, but it is proposed to extend the Transcaspian Railway to Marghelan, which will greatly promote the prosperity of the country. C. C. ADAMS.

Fernald, JAMES CHAMPLIN: clergyman and author; b. in Portland, Me., Aug. 18, 1838; graduated at Harvard College in 1860, and at Newton Theological Seminary in 1863; held Baptist pastorates in Rutland, Vt., Waterville, Me., and Granville, Springfield, and other places in Ohio 1864–89; was on the staff of the *Standard Dictionary*, and editor of the *Students' Standard Dictionary* and of the *Standard Intermediate Dictionary*. He has published *The Economics of Prohibition* (1889): *The New Womanhood* (1891); *Synonyms and Antonyms of the English Language* (1895); *The Spaniard in History* (1898); *Home Training of Children* (1899); and *The Imperial Republic* (1899).

Ferrand, JOSEPH: French jurist; b. in Limoge, in 1827; under the imperial administration he was prefect of the Upper Savoy in the department of l'Ainse until Sept. 4, 1870; took up the public service again in 1871 as prefect of Galvados, which position he retained until 1874; was made an officer of the Legion of Honor in 1866, and was elected as correspondent of the Academy of Sciences in 1888. His publications include *De la Propriété communale en France et de sa mise en valeur* (1859); *Les Institutions administratives en France et à l'étranger* (1879); *La Réforme municipale en France et en Italie* (1881); *Les Pays libres, leur organization et leur éducation d'après la législation comparée* (1884); *L'Organisation municipale de Paris* (1887). F. STURGES ALLEN.

Ferraris, GALILEO: physicist and electrical engineer; b. in Livorno-Vercellese, Italy, Oct. 31, 1847; educated as a civil engineer at the polytechnic school of Turin, and received the degree of doctor of mathematics in 1872. In 1879 he became Professor of Physics in the military school of that city, curator of the physical cabinet and director of the physical laboratory of the Royal Industrial Museum. Ferraris was chiefly known for his researches in applied electricity. He was probably the first to suggest the application of the rotary field to electric motors, and it is to investigations such as his that our system for the transmission of power by means of polyphase currents owes its origin. He was likewise the author of a well-known treatise on *The Theory of Optical Instruments* (1887), which has been translated into German, and of numerous memoirs on technical and scientific subjects. Ferraris was justly recognized as the foremost of Italian electrical engineers. He was one of the official delegates of that government at the Electrical Congress in Paris (1881) and at the Vienna exhibition in 1883. He was one of the chief organizers of the electrical exhibition in Turin in 1884, and in 1886 he organized the Electro-technical School for Engineers in that city. This was the first school in electrical engineering established in Italy. At the electrical exhibition in Frankfort in 1891 Ferraris's method for the polyphase transmission of power had its first practical illustration in the transmission of one hundred electrical horse-power from the waterfalls at Lauffen to the exhibition grounds in Frankfort, a distance of more than 100 miles. At the World's Congress of Electricians in Chicago in 1893 he was a member of the chamber of delegates. Ferraris was a man of affairs as well as a man of science, and almost to the very hour of his sudden death by pneumonia, in Turin, Feb. 7, 1897, he labored for the industrial advancement of Turin and of his country. During the last year of his life he represented Piedmont in the Italian Senate. E. L. NICHOLS.

Fewkes, JESSE WALTER: anthropologist; b. in Newton, Mass., Nov. 14, 1850; graduated at Harvard University in 1875, and for postgraduate work in science received the degrees of M. A. and Ph. D. from that institution in 1877; subsequently for two years he studied zoölogy in the University of Leipzig under Rudolph Leuckart. From 1881 to 1889 he was assistant in the Museum of Comparative Zoölogy in Cambridge with charge of the radiates, and for three years of this time was secretary of the Boston Society of Natural History. He was a student under Louis Agassiz at the Penikese Island School, and for ten summers was associated with Alexander Agassiz in the Marine Laboratory at Newport, R. I. In 1889 Dr. Fewkes became interested in the study of American anthropology, and for four years thereafter visited the Southwest each summer as a member of the Hemenway Archæological Expedition, also participating in the Columbian Historical Exposition held in Madrid in 1892–'93, with charge of the Hemenway exhibits. Since 1895 he has been connected with the Smithsonian Institution, and has visited the West nearly every year, making large collections of archæological material in Arizona. He is now engaged in anthropological studies of the Moki Indians for the Bureau of American Ethnology. Dr. Fewkes holds the rank of Honorary Collaborator of the Smithsonian Institution. He has received the decoration of Isabella la Católica for his work in connection with the Madrid Exposition, and he has also received the gold medal "Litteris et Artibus" from the King of Sweden for his anthropological researches. Dr. Fewkes is a member of a number of scientific societies both in the U. S. and abroad, and is the author of many papers, most of which have been contributed to the *Proceedings* of the scientific societies of which he is a member. His early papers are for the most part on marine zoölogy, with special reference to the medusæ. More recently his published articles have been on his archæological investigations, and on the Moki ceremonies, of which the best known is the *Snake Ceremonies at Wolpi*. He was editor of the four volumes of the *Journal of American Ethnology and Archæology* (Boston, 1891–94).

MARCUS BENJAMIN.

Field, JOHN: pianist; b. in Dublin in 1782; called the "Russian Field." He was the inventor or the introducer of the popular form called the nocturne. He was a pupil of his grandfather, then of Clementi, whom he accompanied to St. Petersburg, which place he afterward left for Moscow. He made many tours through Europe. He was one of the greatest pianists of his time, and left many beautiful compositions, including seven concertos and eighteen nocturnes. D. in Moscow, Jan. 11, 1837. D. E. HERVEY.

Figig: an oasis on the northern edge of the Sahara, 30 miles W. of the boundary between Morocco and Algeria. It is connected by caravan route with the railroad to Oran, has an important trade with Algeria, grows many dates, and with 15,000 inhabitants is one of the most populous oases in the northwest Sahara. At an elevation of about 2,400 feet it stands on the dividing line between the Moroccan and desert vegetation. Caravan routes between Algeria, Morocco, and Tuat converge at Figig, which has also derived importance from the fact that it has often been made a place of refuge for deserters and criminals from Algeria.

Fiji Islands: The white population numbers about 2,000, one-third of whom live in the two principal seaports—Suva, the capital, and Levuka. The whites depend largely for food upon the importation of wheat flour, dairy products, and vegetables from New Zealand and the other Australasian colonies. They have a good local supply of meats (though mutton is mostly imported), poultry and fish, and tropical fruits. The natives adapt themselves readily to a European diet, and when they have money they spend it freely on soft bread, navy crackers, and preserved meats. There are two banks in Suva and one in Levuka. Proximity to Australasia and cheaper rates of freight give that region an advantage in commercial relations with the islands. In Polynesia the external trade of Fiji is second only to that of the Hawaiian islands. The imports in 1896 were $1,178,500 and the exports $2,105,700, and of the total trade Australasia had all but $256,100. There were no exports to the U. S., but kerosene, flour, dried fruit, and shoes were imported to the amount of $11,100. The islands are rapidly rising in commercial prosperity, which depends chiefly upon the development of the rich agricultural resources of the colony. Considerable British capital is invested in the sugar industry, and about 10,000 Indian immigrants have been introduced to work on the plantations. Although lying within the tropics, the islands are exceptionally healthful. For eight months in the year the tropical heat is greatly modified by the southeast trade winds. From November to April wet stormy weather prevails, and between December and March hurricanes sometimes sweep over the islands, doing great damage to the crops. Epidemics are rare and malarial fevers are unknown, but the tropical climate does not seem to be favorable to the health of white women for prolonged periods. C. C. ADAMS.

Finck, HENRY THEOPHILUS: journalist; b. in Bethel, Mo., Sept. 22, 1854, of German parents. In 1862 the family went to Oregon, where Henry and his elder brother Edward both learned the rudiments of music. Henry learned to play both the piano and the violoncello. In 1872 he entered Harvard University, devoting himself chiefly to the classics and philosophy, taking also the music course under Prof. J. K. PAINE (*q. v.*). After graduating in 1876 he went to Europe and wrote accounts of the Bayreuth Festival for the New York *World* and the *Atlantic Monthly*. In 1877 he returned to Cambridge and received a Harvard fellowship, which enabled him to study three years in Berlin, Heidelberg, and Vienna. During this period he wrote many articles for English and American magazines, together with letters to the *Nation*, New York, which resulted in his appointment as one of the staff of that paper, and he has since held the position of music critic and book reviewer on the *Nation* and *Evening Post*. Books written by him are *Romantic Love and Personal Beauty*; *The Pacific Coast Scenic Tour*; *Spain and Morocco*; *Chopin and other Musical Essays*; *Wagner and his Works*; *Songs and Song-writers*, and he is now engaged on a work describing the gradual evolution of romantic love from the Australian savages to civilized Europeans. D. E. HERVEY.

Finisterre Mountains: the central of the three ranges of high mountains, the Coast, Finisterre, and Bismarck chains, parallel with one another and the coast in German New Guinea between 46° and 47° 30′ E. lon., with 6° S. lat. as the northern boundary. Of the highest peaks of Finisterre, Kant rises to a height of 11,400 and Schopenhauer to 11,000 feet, and the steep high range of volcanic rock is in sharp contrast with the coral formation of the coast, only 35 miles distant. The range was explored in 1888 by Zöller, who saw the still higher Bismarck range about 50 miles farther inland, of which Mt. Wilhelm, about 16,000 feet high, is supposed to be the highest point of German New Guinea.

Finland: The population of Finland in 1897 was 2,527,801, and of Helsingfors 66,000. Only 10 per cent. of the people are settled in towns and about 80 per cent. are engaged in agriculture. Thirty-eight per cent. of the cultivated land and all the forests are the property of the state, the Church owns about 2 per cent., and the remainder is distributed in very small portions among private individuals. The woods cover 64 per cent. of the whole area. Only 8 per cent. of the entire surface is cultivated. The beautiful lakes and the abundant fishing and shooting in the moors and wastes are drawing tourists to the country to some extent. Shooting is now prohibited during most of the shooting season, but spotted trout and salmon are taken in great abundance. Finnish is spoken by about 85 per cent. of the people, Swedish by 14 per cent., the Russian-speaking inhabitants number about 5,000, not including the Russian garrisons, while the Lapps number only about 1,000, and other nationalities about 3,000. The exports in 1896 were valued at $1,698,313, of which more than half was timber; the imports were $8,201,529, of which the largest items were iron, steel rails, corn, flour, coffee, sugar, and manufactures. A line of weekly steamers from New York and Boston to Hull connects at that port with steamers plying weekly to Helsingfors. C. C. ADAMS.

Finley, JOHN HUSTON, A. M.: educator; b. in Grand Ridge, Ill., Oct. 19, 1863; prepared for college in Ottawa, Ill., high school; A. B., Knox College, 1887, and A. M. 1890; student in Johns Hopkins University 1887–89; secretary of State Charities Aid Association, New York, 1889–92; president of Knox College 1892–99; associated with R. T. Ely in the authorship of *Taxation in American States and Cities*; editor of *Charities Review* 1891–96; contributor to magazines, reviews, etc. C. H. THURBER.

Finsch Haven: the first capital of German New Guinea, a little N. of Huon Gulf, in 6° 30′ S. lat., 147° 51′ E. lon. It was named in honor of the German explorer Finsch, who first surveyed this part of the coast and described the land and people. In this harbor vessels may ride at anchor in 60 to 70 feet of water, wholly protected from winds. The capital was finally transferred to the more centrally situated Friedrich Wilhelms Haven, another excellent harbor N. of Astrolabe Bay, in 5° 15′ S. lat., 145° 45′ E. lon.

Fiore, PASQUALE: jurist; b. in Terlizzi, Italy, Apr. 8, 1837; studied law at the University of Naples, and in 1861 was made Professor of Philosophy at the Lyceum in Cremona, in 1863 Professor of International Law at the University of Urbino, and two years later Professor of International Law at the University of Pisa, whence after ten years he went to Turin and afterward to Naples. He has published a number of important judicial works, including *Droit international privé*, (1874); *Traité de droit penal international et de l'extradition* (1880); *Nouveau Droit international public* (2d ed. 1885). F. STURGES ALLEN.

Fisher, FRANCES C. (*Christian Reid*, Mrs. Tiernan): author; b. in Salisbury, N. C. *Valerie Aylmer* (1870), which was uncommonly successful, was followed by *Morton House*, a story of Southern life, which appeared serially in *Appletons' Journal*. Other books of hers are *Mabel Lee* (1871); *Ebb Tide* (1872); *Nina's Atonement* (1873); *A Daughter of Bohemia* (1873); *Carmen's Inheritance* (1873); *A Gentle Belle* (1875); *Hearts and Hands* (1875); *A Question of Honor* (1875); *The Land of the Sky* (1875); *After Many Days* (1877); *Bonny Kate* (1878); *A Summer Idyl* (1878); *Hearts of Steel* (1882); *Armine* (1884); *Roslyn's Fortune* (1885); *Miss Churchill* (1887).

Fitch, John Lee: artist; b. in Hartford, Conn., June 26, 1836. He studied in Munich and Milan, his professional life being spent in Hartford and New York city; is an associate of the National Academy of Design, and was for twelve years chairman of the art committee of the Century Association, declining re-election. Among his paintings are *In the Woods*, a large canvas exhibited in Philadelphia in 1876; *On Gill Brook*; *A Mountain Brook*; *The Outlet*; *In the Cañon*; *Waiting for a Bite*; *A Stray Sunbeam*; *Twilight on John's Brook*; *Cliff Side*; and *Willows on the Croton*.

Fitzpatrick, Charles: lawyer and politician; b. in Quebec, Canada, Dec. 19, 1853; graduated at Laval University in 1873; admitted to the bar in 1876. He was counsel in 1885 for Louis Riel, who was executed for high treason. In 1892 he defended ex-Premier Mercier in the prosecutions which followed his administration. In 1897 he represented the Dominion Government in the fisheries case before the privy council, England. He was a member of the Quebec Assembly 1890–96, and then became a member of the House of Commons, and was appointed in July, 1896, solicitor-general under Sir Wilfrid Laurier.

Flagg, George Whiting: artist; b. in New Haven, Conn., June 26, 1816. His early years were passed in Charleston, S. C., where he studied art with Washington Allston, his uncle, at which period he painted a portrait of Bishop England, *A Boy Listening to a Ghost-story*, *A Young Greek*, and *Jacob and Rachel at the Well*. His *Murder of the Princes* attracted the attention of a gentleman through whose aid he spent several years in Europe, living for some time in London; returned to New Haven, and afterward to New York; became a member of the National Academy of Design in 1851. Among his best-known works are *Landing of the Pilgrims*; *Washington Receiving his Mother's Blessing*; *The Good Samaritan*; *Columbus and the Egg*; and *The Scarlet Letter*. D. in Nantucket, Mass., Jan. 5, 1897.

Flagler, Isaac V.: organist; b. in Albany, N. Y., May 15, 1842, and became a church organist when twelve years old. He then went to Paris and studied under Batiste. He has played the organ in several churches, including Plymouth church, Chicago, for seven years. He has composed many organ pieces, his *Variations on an American Air* being a great favorite. He also composed a comic opera. He has given many organ recitals and lectures, and was for several years organist and musical lecturer at Chautauqua. He is organist of the First Presbyterian church, Auburn, N. Y. D. E. Hervey.

Flagstaff: a town in Coconino co., Northern Arizona, on the Atlantic and Pacific R. R., 6,864 feet above sea-level. On every side of the town pine lands spread for miles away, while outside this verdant area stretches the desert country. Flagstaff has a population of 1,500, and its sawmills and cattle and sheep interests are the sources of its growth and prosperity. To the north of the town are the San Francisco Mountains, through whose instrumentality this region derives its economic importance. These mountain peaks arrest and precipitate the clouds which would otherwise pass over the plateau and find no cause for precipitation over the eastern desert. The result is that a part of the desert has been turned into pineries and grass-lands. These mountains are the only elevation in Arizona on which snows accumulate, and melting in the spring they furnish supplies for many brooks, washes, and at least one perennial stream, Oak creek. Pop. (1890) 963; (1900) 1,271.

Fleming, John Ambrose, D. Sc.: physicist; b. in Lancaster, England, Nov. 29, 1849; educated at St. John's College, Cambridge. In 1871 he was science master at Rossall College; in 1873 demonstrator at the Royal College of Chemistry in London. In 1874 he was appointed teacher of physics at Cheltenham College, which position he resigned in 1880 to become demonstrator in applied mechanics at the University of Cambridge. In 1879 Mr. Fleming received the degree of doctor of science from the University of London and soon afterward was elected to the chair of Mathematics and Physics in the new University College at Nottingham. He resigned this professorship for the chair of Electrical Engineering in London. In 1883 he was elected a fellow of St. John's College, and in 1885 was appointed to the chair of Electrical Technology in University College, London. Fleming is the author of numerous papers on applied electricity, of a volume entitled *Short Lectures to Electrical Artisans*, and of a treatise in two volumes on *The Alternating Current Transformer*. E. L. N.

Floeberg Beach: the most northern point ever reached by a ship in the American Arctic; on the shore of the Arctic Ocean, at the northeast extremity of Grant Land. 82° 25′ N. lat., 62° W. lon. Captain George Nares in the fall of 1875 pushed his ship, the Alert, northward along the west shores of Kennedy and Robeson channels to Floeberg Beach, where he spent the coldest winter that Arctic explorers had experienced up to that time. From this point a sledge expedition under Markham advanced northward to 83° 20′, the farthest north attained up to that date; and another under Lieut. Aldrich traced 220 miles of new coast along the west and northwest shores of Grant Land.

Florence, University of: The city of Florence early took an interest in education, in 1320 engaged and paid some individual teachers, and in 1331 began to take steps for founding a *studium generale*. Not until 1349, however, on the earnest insistence of the authorities, did it receive from the pope the charter for the institution, which did not have altogether a brilliant existence, though law and theology were diligently pursued. Studies were suspended from 1354 to 1357. From 1373 to 1375 Boccaccio lectured in the university on Dante. From 1378 to 1383 studies were again interrupted; on Feb. 14, 1488, the high school received its own statutes. In 1396 Florence had the honor of taking one of the most important steps in the revival of learning, "for in the spring of this year the *studium* at Florence addressed an invitation to Manuel Chrysoloras at Constantinople to accept the chair of Greek Letters as first professor of the Greek tongue in the West. From this invitation, couched in words of great dignity worthy of the men who sent it, date the beginnings of Greek learning in Italy." In 1472 the university was transferred to Pisa. The present institution was not founded until June 30, 1872, under the direction of the royal Government in Italy. There are at present about 500 students. At the time of the revival of the study of antiquity Florence played an important part, the names of Boccaccio, Salutati, and Niccoli being specially associated with the movement. See *Minerva*; Woodward, *Vittorino Da Feltre and other Humanist Educators*. C. H. Thurber.

Florida: In Feb., 1899, a cold wave invaded Florida, greatly damaging her orange and other fruit industries. At least five disastrous freezes have occurred in Florida in this century. It is believed that the cold wave of 1835 was the most severe of the series. Fifty-one years elapsed before Florida, in Jan., 1886, was again visited by severe frost. In Dec., 1894, and Feb., 1895, there were cold waves that killed about three-fourths of the orange-trees down to the roots. In 1898 fruit from the trees that sprang from the old roots came into the market, and the crop was about half as large as that of the year before the 1894 disaster. It was thought in 1898 that the Florida orange crop would reach its former proportions in about ten years, but the industry received another setback by the cold wave of 1899, and increased the tendency in Florida to substitute other crops for oranges. Many orange-growers since 1894 have turned their attention to other products and have prospered. They are growing tobacco, are giving more attention to vegetables for Northern markets, and not a few have gone into stock-raising.

Flynn, Edmund James: lawyer and law professor; b. in Percé, Province of Quebec, Nov. 16, 1847; graduated at Laval University in 1873, in which year he was called to the bar; practiced his profession in the city of Quebec, and since 1874 has been Professor of Roman Law at Laval University. He has always been active in political affairs, and in 1878–79 was a member of the Provincial Legislature; was appointed Commissioner of Crown Lands in 1879, retaining this office until 1882; Commissioner of Railways and Solicitor-General 1884–87; was again Commissioner of Crown Lands 1892–96, in which last year he became Premier of the province with the office of Commissioner of Public Works. Retired from office May 22, 1897, on the defeat of his party at the polls. F. STURGES ALLEN.

Foreign Corporations: in law, corporations organized and existing under and by virtue of the laws of a foreign state. A corporation is not a person in the sense that a natural person is, although for most purposes of legal administration it is considered and treated as a person. A corporation existing under the laws of one State in the U. S. is held to be a foreign corporation in all other States, it being settled that a corporation is not a citizen within the meaning of the constitutional provision entitling "the citizens of each State to all privileges and immunities of the citizens in the several States." It follows, therefore, that, as well among the several States of the U. S. as between other independent sovereignties, corporations have no recognized legal existence as such outside of the State under and by virtue of whose laws they exist. The corporation legally exists only in the jurisdiction where the laws under which it is incorporated exist and are obligatory.

The Status and Powers of Foreign Corporations.—In the U. S. the status and powers of foreign corporations are a matter of special importance, because of the rapidly increasing number of corporations organized under the laws of one State for the purpose of doing business in other States. It is a common practice to organize a corporation under the laws of any particular State which for any reason may offer the most favorable conditions for the transaction of the business contemplated for the corporation. How far the powers granted or permitted by these States to corporations organized under their laws shall be recognized by other States in which they are authorized by their charters to do business becomes a matter of very great importance, both to the incorporators and to subsequent stockholders, as well as to the citizens of the State in which the corporation is transacting its business.

In foreign nations, such as Great Britain, France, and the U. S., etc., a corporation organized under the laws of one nation has no existence or powers legally except such as may be granted to it by the law of comity. But under the laws of the U. S., where all of the States, although considered independent sovereignties, are still subject to the Constitution of the U. S. and the laws passed in pursuance of it, the status and powers of the corporations organized in one State and doing business in other States are somewhat modified. It is settled, however, that a corporation is not a natural person in the sense that it is entitled to the privileges and immunities accorded to the citizens in the several States. The tendency at present of the Federal courts seems to be to enlarge the powers and immunities of corporations; but, notwithstanding this, it is still held that a corporation can have no powers and enter into no contracts in another State except by the permission, express or implied, of the foreign State in which it is attempting to do business. Comity, however, usually affords to foreign corporations, in the absence of express statutory restriction, the authority to do and perform those acts and contracts which are generally allowable for domestic corporations, so far as they are within the powers conferred by its own charter or certificate of incorporation.

In the U. S., in general, a corporation created in one State may establish agencies for the transaction of its business in another State, may make and receive contracts which a natural person there may make or receive, may maintain actions for the enforcement of contracts, and set up a defense against actions brought against it, and, in general, have the same benefits of its contracts and remedies at law as a natural person would have in such State. This is true in the absence of express statutory restrictions; but such restrictions are now becoming general in the separate States. These restrictions in general provide that a corporation shall not bring or maintain an action at law or in equity, or be allowed to appear or defend in an action at law or in equity, unless it has complied with certain provisions regulating the transaction of its business, and obtained a certificate from the proper officer (usually the Secretary of State) authorizing it to do business in that State; and in case of the existence of such a statute the corporation can not bring or defend an action upon any event or cause of action arising subsequent to the passage of the statute without compliance with it. Such statutes are generally passed for the purpose of enforcing the payment of taxes on personal property situated within the foreign jurisdiction, and for the purpose of compelling corporations engaged in banking, in the issuing of insurance, or in other business affecting public interests more or less directly, to submit to the rules of the insurance, banking, or other department existing in that jurisdiction. Under such statutes a State may place a prohibitive tax upon a foreign corporation if it sees fit to do so.

It is held that the Federal Government has jurisdiction over the business of corporations engaged in interstate commerce, and that the power of the separate States to regulate and tax foreign corporations is restrained so far as it relates to business coming within the jurisdiction of the interstate commerce laws, such commerce receiving the same protection when carried on by corporations as when carried on by individuals.

Restrictive statutes are usually expressed as applying to foreign corporations "doing business" in that State; and it has been generally held that isolated transactions performed by a corporation of one State in another State do not constitute "doing business" within the foreign State, but that the foreign corporation must do a substantial part of its business within the foreign State—such as by maintaining a sales agency, or maintaining part of its manufacturing plant there, or the like. A corporation, therefore, is commonly not restricted from conducting the ordinary operations of commerce by such a statute.

Contracts made in violation of such restrictive statutes by corporations which have not complied with the provisions of these statutes are generally held to be voidable at the election of the other party to the contract, or the remedy is suspended until the statute is complied with; but the corporation can not set up its own non-compliance with the statute as a defense to an action to compel it to perform its contract or for damages for non-performance of it. In some States it is held that contracts made as above are void only when the statute expressly so provides; in others, that they are not void when the statute merely provides a penalty.

The Power of a Foreign Corporation to Hold Land.—No general rule can be stated as to the power of a corporation to take, hold, and transmit title to land in a foreign State; but reference must be had in each particular case to the decisions and statutes of the State in question. In many of the States, as in New York, enabling statutes have been passed, either authorizing corporations to hold land in general or under certain special restrictions; and it has been decided in some cases that in the absence of prohibitory statutes the corporation of one State may hold land in another State if authorized so to do by its charter or certificate of incorporation, unless forbidden either by public policy or by statute. In all cases where the right of a foreign corporation to hold land is in question the law of the State where the land is situated governs.

Corporations generally, like other non-residents, are required to give bonds for costs in civil actions in the courts of a foreign State.

Service of Papers upon a Foreign Corporation.—The service of papers in an action upon foreign corporations is generally regulated by statutes, and they are ordinarily required to designate some person or corporation to act as an agent upon whom papers may be served, to the same effect as if upon the corporation. In general, jurisdiction can not be acquired by service upon an officer within the State for purposes not connected with the business of the corporation; but where service is made upon an officer of the corporation engaged in its business, or representing the company there in its business, such service is held to be good and to confer jurisdiction.

For the purposes of Federal jurisdiction in actions in the U. S. a corporation is a person, and when sued in a State foreign to the State of its domicile it may remove the cause to a Federal court, in the same manner as a natural person might. This is true, even though the corporation may be doing business in the foreign State under a certificate authorizing it to do so, obtained from the proper officer; but where the corporation has received corporate privileges in the foreign State it then becomes a citizen of that State for the purposes of jurisdiction as well as of the State under which it was first created. See Murfee's *Law of Foreign Corporations*; Reno's *Non-residents and Foreign Corporations*; Thompson's *Commentaries on the Law of Private Corporations* (vol. vi.); Beach's *Commentaries on the Law of Private Corporations.* F. STURGES ALLEN.

Forel, FRANÇOIS ALPHONSE: b. Feb. 2, 1841, at Morges, Canton Waadt, Switzerland; studied medicine and natural history in Geneva, Montpellier, Paris, and Würzburg, and

is Professor of Anatomy and Physiology at the University of Lausanne. He has given very large attention to the study of the physical conditions of the Swiss lakes, and has made most important contributions to the comparatively new branch of research known as limnology, or the study of lakes. The methods of pursuing these researches are largely based upon those he originated. Among his many monographs and books are *Introduction à l'étude de la faune profonde du lac Léman* (1869); *Températures lacustres* (1880); *Die pelagische Fauna der Süsswasserseen* (1882); *La thermique de la Méditerranée* (1891); and his exhaustive study *Le Léman: Monographie limnologique* (1892).
C. C. ADAMS.

Formosa: The U. S. had a larger share of the trade of Formosa in 1897 than any other country except China. The total foreign trade of the island, excluding China, was $5,500,000, of which about three-fifths fell to the U. S. The principal imports from the U. S. are petroleum, flour, and ginseng. Tea is the largest export. A drawback to commerce is the fact that the rivers are navigable only to a very limited extent. With the exception of the small inlets at Sao-o and Black Rock Bay, into which junks may run, the entire east coast offers no protection for vessels. Kelung, on the north coast, has a good depth of water and is open at all tides, but the inlet is narrow and much exposed during the winter monsoons. The harbor of the leading port, Tamsui, on the northwest coast, is merely the estuary of an insignificant river, with a shifting bar, which ocean vessels of any size do not attempt to cross. The lagoon at Takao, on the southwest coast, offers complete shelter and good holding ground, and is likely to become an important center of foreign trade. The Japanese cabinet has approved the recommendation of the Formosan Government for an appropriation of $20,000,000 in gold to improve Kelung harbor and extend the railroad now running from that port to Teekcham, 60 miles, to Takao, 175 miles farther S. Formosa is one of the largest sources of the supply of camphor, and more than 4,000,000 lb. of it was exported in 1894. Inasmuch as the tree is destroyed to obtain the gum, a more stringent enforcement of the law requiring that a tree be planted for each one destroyed will be required to prevent a diminution of the supply.

Fort Chipewayan: a Hudson Bay post near the southwest end of Lake Athabasca, Northwest Territory, Canada. It is at the mouth of the Athabasca river. It has been necessary to shift the position of the station several times on account of the changes in the alluvial delta. Missionaries have long maintained an orphanage here with 60 to 100 inmates, making the place the most populous white station in the Mackenzie river basin between Lake Athabasca and the Arctic Ocean.

Fort Churchill: a Hudson Bay post at the mouth of the Churchill river, west coast of Hudson Bay, Keewatin District, Canada. The west coast of Hudson Bay is low, with shallow water, and the only harbor available for large vessels at all stages of the tide is at Fort Churchill, where there is perfect shelter, an easy entrance, and 6 to 8 fathoms of water.

Foulke Fiord: one of the indentations on the northwest coast of Greenland, in 78° 18′ N. lat., 73° W. lon. The early explorers of the Smith Sound region found in the fiord the Eskimo village of Etah, which is supposed to be the most northern place of human abode in recent times, though the remains of Eskimo huts have been found farther N. on the coast of Grinnell Land. In the fall of 1860 Dr. I. I. Hayes, from Foulke Fiord, traversed the inland ice for 40 miles, the most successful attempt up to that time to penetrate the interior of Greenland. He spent that winter in the fiord with his exploring schooner, United States.

Foureau, foo'rō', FERDINAND: an African explorer. He completed in 1898 his ninth expedition among the sand wastes and oases S. of the Sahara, which he had been prosecuting, chiefly at the expense of scientific societies and private citizens of France, for about ten years. His routes cross one another in all directions from the southern limits of Algeria across the Erg wastes and into the country of the Tuaregs, and maps of that large region are now chiefly based upon his surveys, which include the determination of many heights and the position of a large number of places. In the course of this work he corrected many errors of the earlier maps. The information he collected stimulated the extension of French influence to the S. and the establishment of advanced military posts. Early in 1899 Foureau arrived with a large expedition at Agades, in the southern part of the Sahara, on his way to explore, under Government auspices, the parts of the Sudan that are in the French sphere of influence. Besides a number of reports and maps printed chiefly by the Paris Geographical Society, he has published these books: *Une Mission au Tademayt, territoire d'Insalah en 1890* (Paris, 1891); *Ma Mission chez les Touareg Azdjer* (Paris, 1894); *Mission chez les Touareg: Mes deux itinéraires Sahariens, Octobre, 1894, à May, 1895* (Paris, 1895).
C. C. ADAMS.

Fournier, PAUL EUGENE LOUIS: French jurist; b. in Calais, Nov. 26, 1853; studied at the School of Records, and received a diploma as paleographer of archives in 1879; received his doctor's degree in law, was appointed Professor of Roman Law at Grenoble, and afterward president of the academy of that village. He is well known for his historical studies of the Middle Ages and of ecclesiastical tribunals. He has published *La Question agraire en Irlande* (1882); *La Question des fausses décrétales* (1887); *Notice sur la bibliothèque de la Grande Chartreuse au moyen âge, suivie d'un catalogue de cette bibliothèque au XVe. siècle* (1888); *Le Royaume d'Arles et de Vienne, 1138–1378* (1891). F. S. A.

Fourtou, foor'too', MARIE FRANÇOIS OSCAR, de: statesman; b. in Ribérac, department of Dordogne, France, Jan. 3, 1836. He was mayor of Ribérac under the empire. In 1871 he was elected to the National Assembly, and took his place in the Right Center. In 1872 he was Minister of Public Works for a few weeks, retiring with Jules Simon. In 1873 he was for five days Minister of Worship in the last cabinet formed by Thiers. On Nov. 26, 1873, he became Minister of Public Instruction, Worship, and Fine Arts, and was Minister of the Interior in 1874, and again in 1877. M. de Fourtou became a Senator in 1880, and in 1889 he returned to the Chamber of Deputies. D. in Paris, Dec. 6, 1897.

France: The census of Mar., 1896, showed a total population of 38,517,975, an increase of only 174,783 in five years. The increase in population in the period 1886–91 was only 124,289, while in the period 1881–86 the augmentation was about 545,000. On the whole, the rate of increase in the population has considerably diminished in the last fifteen years. As a rule the towns are growing at the expense of the country, showing the growth of industrial and a small decline of agricultural interests. The birth-rate is below that of most civilized countries. The small increase in population is attributed in large part to the fact that a standing army of more than 500,000 men prevents many from marrying, and that enforced military service makes it impossible for many to marry till late in life, for, after leaving the army, they must first find positions that will enable them to support families.

France continues to be the largest wheat-growing country in Europe, and, next to the U. S., the largest in the world. Wheat is raised in all parts of the country, but particularly N. of the Seine. The average crop for the five years ending 1898 was 330,189,873 bush. Since the advent of phylloxera and other maladies of the vine France has given more and more attention to the production of her own food-supply. Oats are raised extensively in the north and northeast, buckwheat in the northeast, and rye in the central regions, while maize is grown in the Rhône valley and in the southwest. The culture of cereals occupies a little more than a quarter of the total surface, more than one-half of the cultivable area, and wheat occupies nearly one-half of the land devoted to cereals. Still France for a number of years has imported more cereals than have been exported. An increase in wheat imports from the U. S. is attributable to the prevailing opinion that a mixture of the American with the softer French wheat makes the best flour that can be produced. It is said that the inhabitants of Southern France consume more bread *per capita* than any other people. Meat is expensive and to the poor a luxury, and bread and cheap wine are the food and drink of most of the people. About half the flour imported at Marseilles comes from Algeria, and about half the wheat from Russia. In 1900 the wine product was 1,779,264,201 gal., and the cider product, which is an important industry in the north, was 776,897,553 gal. The wool product has been diminishing for many years. In 1840 the number of sheep was 32,151,430; in 1882, 23,809,433; in 1900, 21,357,660. Formerly the end sought in sheep-raising was to produce breeds equal to the merino type, but, owing to the low price of wool, in recent years sheep-farmers have sought to breed animals giving the best market value in meat. Wool has, therefore, diminished in quantity, and the quality has not improved. The best wool, fine and firm, is produced in Champagne, Soissonnais, Vexin, and Île-de-France.

In 1895 there were 55,458 industrial establishments in France. The enterprises devoted to textiles and clothing numbered 6,471; metals, 4,791; mines and quarries, 3,031; foods, 8,782; building arts, 6,602; agriculture (sugar-making, flour, etc.), 14,813; chemical and tanning, 3,117; paper, printing, furniture, etc., 3,421; state services, 430. The total horse-power employed was 1,163,005. In the quantity of its industrial products France comes after the U. S., Great Britain, and Germany, but it holds the first place in the workmanship and quality of many articles. The principal centers of manufactures are Paris, the north, and the southeast, though these industries are distributed over most of the country. Textile production (woolens, silks, cottons, linens, etc.) takes the first rank, with a value of about $700,000,000 a year and employing 600,000 workmen. Woolen goods come first in the value of the product, which is about $250,000,000, with an export of about $70,000,000. As the country does not produce sufficient wool, about three-fourths of the amount consumed is imported, a large part of it coming from Argentina and Uruguay. The export of silk manufactures amounts to about $50,000,000, and as silkworm-breeding in the Rhône valley does not supply sufficient material, a large amount of the raw silk used comes from Italy and China. Cotton manufactures have recently made considerable advance, and are using about a third more raw material than in 1890. The linen industry has for some years been in an unfavorable condition, while jute manufactures have been growing, as new uses for this material are being found. In the metal industry France is far behind Germany, but has improved within a few years, as the imports of iron and steel manufactures are diminishing, while the exports tend to increase. The production of leather and leather goods has somewhat declined, and also the exports of underwear and paper goods.

The exports in 1897 were $719,600,000, of which about one-third went to Great Britain, one-seventh to Belgium, one-twelfth to Germany, one-thirteenth to the U. S., and nearly as much to Algeria. The imports were $791,200,000, of which about one-eighth came from Great Britain, one-eighth from the U. S., one-ninth from Germany, one-fifteenth from Belgium, and nearly the same amount from Algeria. In 1899 the general exports were valued at $1,067,965,500 and the imports at $1,128,664,000. More than half of the exports were manufactured articles, about one-quarter were manufacturing supplies, and about one-sixth food-supplies. More than half the imports were manufacturing supplies, about one-seventh manufactured articles, and more than two-sevenths food-supplies. The notable increase in imports was largely due to heavy receipts of wheat, and there was a decrease in exports. Colonial imports foot up about $70,000,000 a year and the exports to about the same figure.

The French Government is protectionist to an extreme degree, and extends remarkable support not only to its commerce, but also to its merchant marine. A bonus is paid to all ship-builders on the basis of the tonnage they produce, and also to all ships, steam or sail, based on mileage. Technical education probably receives more attention in France than in any other country, except Germany. It exists in Paris in all classes of industry where skilled labor is required, and in all cities known for a particular product there are usually one or more technical schools, many of which receive substantial aid from the Government. Although the existing U. S. tariff is a cause of much complaint from the French, their tariff on many American products is prohibitive, and any increase in the U. S. tariff on articles exported from France is at once met by an increased rate on some product of the U. S.

The merchant marine in 1900 numbered 15,489 vessels, of which 14,262 were sailing. The chief ship-building yards in France are those of the Messageries Maritimes, which produce only their own ships; the Compagnie Générale Transatlantique; the shipyards of the Gironde at Bordeaux, which produce a considerable number of war-ships; at Nancy, where sailing vessels of a maximum of 3,000 tons and small steamships are built; at Rouen, the shipyards of Normandie; the Forge shipyards of the Mediterranean, and the shops and yards of the Loire, each enterprise owning two important ship-building plants.

The recent completion of the large scheme of harbor and dock improvements at Calais has added much to its importance as a seaport. Extensive improvements have also been made in the harbor of Rouen, and the increase in its shipping trade has been greater than that of any other port of France. The ports of Boulogne-sur-Mer, Dieppe, and Dunkirk have all been favorably affected by the improvements of recent years.

An agreement between England and France settling their dispute as to their respective spheres of action in the Sudan was reached in Mar., 1899. From the northern frontier of the Belgian Congo to the fifteenth degree of latitude the delimitation of the boundary will be carried out by a mixed commission, it being understood, in principle, that Great Britain retains the Bahr-el-Ghazal and Darfur, while France includes in her sphere Wadai and Bagirmi, likewise Kanem, and, generally speaking, the territories to the E. and N. of Lake Chad. N. of the fifteenth degree of latitude, Great Britain recognizes that the French sphere extends S. of the tropic of Cancer as far as the line which, broadly speaking, coincides with the western limit of the Libyan Desert. From the Nile to Lake Chad, and between the 5th and 15th parallels, the two powers mutually concede equality of treatment in commercial matters. This clause will thus permit France to have commercial establishments on the Nile and its affluents. Finally, the two powers mutually undertake to refrain from exercising political or territorial rights outside of the frontiers fixed by the arrangement.

C. C. Adams.

France, History of: The history of the Third Republic is, on the surface, one of rapid ministerial changes. Into the details of these changes it would be profitless to enter. The responsibility of a whole ministry is not as clearly defined as in England, while the French system of political groups is in striking contrast to the lines of demarcation between the two dominant British parties. As premier swiftly succeeded premier, observers might naturally doubt the stability of the republic. Yet it has lasted twenty-eight years. The Legitimists and Orleanists coalesced, and this united Monarchical Right has dwindled to a small minority. The Bonapartists, or Imperialists, have little parliamentary strength. On the other hand, the Republicans have steadily grown. They are split, however, into various groups, "Rallied" ex-Monarchists, Opportunists, Radicals, Socialists, etc.

Our survey may begin with Boulangism. Gen. Boulanger as officer and Minister of War gained wide popularity with the army and the public. His moderate abilities were supplemented by certain military reforms and an attractive personality in the eyes of the masses. He had come to Paris at the time of the governmental crisis in 1887, but he hesitated to strike a blow. He championed the cause of revision of the constitution, and was elected deputy in 1888. His popularity, somewhat impaired by a duel with Floquet, was regained; he was supported by very diverse elements—Monarchists, Bonapartists, anarchists, and many Republicans. Chosen deputy for the department of Seine in 1889, he could not resolve to execute a *coup d'état*. His programme was abolition of the parliamentary republic by a constituent assembly. The Government acted firmly. It suppressed the so-called League of Patriots, and decided to try Boulanger. He fled to Brussels, and was in his absence condemned to imprisonment on charges of conspiracy, treason, and misappropriation of funds. With his death in exile, two years later, Boulangism collapsed.

Carnot was then president. He was assassinated by an anarchist in 1894, and was succeeded by Casimir-Périer; the latter resigned early in 1895, on the ground that he was "irresponsible, and unable to answer attacks." M. Faure was his successor. Faure died in office in 1899, and was followed by M. Loubet. Besides the presidents, the statesmen of the last ten years include Freycinet, Ferry, Clémenceau, Ribot, Tirard, Méline, Dupuy, Rouvier, Hanotaux, Goblet, Constans, Brisson, and Floquet.

The act of an anarchist has been mentioned. Anarchism and strikes have been subjects demanding the attention of Government. The tariff was materially raised in 1891. After weathering Boulangism the republic was exposed to the Panama scandal. The great name and achievements of De Lesseps had involved the French deeply in the Panama Canal project. The collapse of the enterprise dragged down the reputations of various politicians, ministers, and journalists. A parliamentary investigation in 1893 resulted in the imprisonment of Charles de Lesseps and the trial for corruption of several senators, deputies, and officials.

Meanwhile the Franco-Russian *entente* was progressing. The chief steps that mark the formation of the Dual Alliance as a counterpoise to the Triple Alliance may be thus summarized: The visit of a French fleet to Cronstadt in 1891; the return visit of a Russian fleet to Toulon in 1893; the journey of the czar to France in 1896; and the tour of President Faure to Russia in 1897. On the last occasion the executives made use of the term "friendly and allied nations," thus formally indicating the fact of an understanding. Other recent important events were the constitutional crisis, in 1896, regarding the power of the senate; the adverse criticism on the mismanagement in Madagascar; the increased attention to the navy; and, in 1898–99, the Fashoda question, relating to the upper Nile region, a matter which nearly embroiled France with Great Britain.

All these things have been overshadowed by the "Dreyfus case." Capt. Dreyfus, an officer in the army, of Jewish descent, was apprehended in 1894 and sent by military court order to Devil's island, off the tropical coast of South America. Much mystery marked the occurrence, but it was understood that he was charged with betraying military secrets to a foreign power. Several attempts were made to reopen the case, notably by the novelist Zola in 1898. Anti-Semitism and the necessity of standing by the army were invoked. The matter was finally referred to the court of cassation, and he was brought back and tried and again pronounced guilty; but he was immediately pardoned and left the country.

This unfortunate incident, with the sudden death of President Faure, led to an ominous increase of activity on the part of the Bonapartist and Orleanist claimants, and caused skeptics to renew their doubts about the life of the Third Republic. Doubters may well offset against turbulent demonstrations in Paris the stability of the provinces, and against the staggering load of debt they may set the marvelous recuperative power displayed by France at many critical occasions. EDMUND K. ALDEN.

Franklin, SAMUEL RHOADS: naval officer; b. in York, Pa., Aug. 25, 1825. He was appointed midshipman in 1841; was in the action at Monterey, in the Mexican war, and was made passed midshipman 1847; served in the Coast Survey 1853–55; was commissioned master and lieutenant 1855; after service in the North Atlantic and the Brazilian squadrons and on the Atlantic coast, from 1855 to 1862, he became executive officer of the Roanoke, on board of which vessel he had been in her action with the Merrimac, when the Cumberland and the Congress were destroyed; he was commissioned lieutenant-commander in 1862, was with the Gulf blockading squadron in 1863, and on special duty at New Orleans 1864; in 1865 he participated in operations in Mobile Bay, being on the staff of Acting Rear-Admiral Thatcher, and was the naval representative in the demand for the surrender of Mobile; was made commander in 1866, and advanced to captain in 1872, being subsequently transferred to duty as hydrographer to the Bureau of Navigation at Washington; he was promoted to commodore in 1880, was placed on special duty in the Bureau of Equipment, and became president of the board of examiners 1883; was made rear-admiral in 1885, and was assigned to duty as superintendent of the Naval Observatory; he became commandant of the European station in 1886, and was retired in 1887.

Franko: the patronymic of a talented musical family, consisting of the brothers SAM and NAHAN and the sister, JEANNE, all violinists and pianists. They were all born in New Orleans, La., the children of a wealthy Jewish merchant there. Nahan was born July 23, 1862, and began the study of the violin very early. He made his first appearance in Steinway Hall, New York, Sept. 17, 1869, with the Carlotta Patti Concert Company. The next year he went to Europe and studied under famous teachers for seven years. He played at many concerts, and has been also quite successful as a conductor. Since his return from Europe he has always resided in the vicinity of New York. The sister, Jeanne, was also educated in Europe, and she too has made New York her artistic home. She is a good pianist, but a better violinist. The brother Sam is also a good performer, but less known than Nahan and Jeanne.

D. E. HERVEY.

Franks, Sir AUGUSTUS WOLLASTON: archæologist; b. in Geneva, Switzerland, in 1826; educated at Eton and Cambridge, England, and received the degree of M. A. in 1852. His first book, *Ornamental Glazing Quarries*, was published in 1849. He was considered one of the greatest authorities on the arts of the Renaissance and Oriental keramics. He was for many years keeper of the department of British and mediæval antiquities in the British Museum, and presented to the museum a collection of Chinese and Japanese porcelain and pottery and examples of Italian majolica and other wares. He was knighted in 1888. He wrote *Recent Excavations and Discoveries on the Site of Ancient Carthage* (1860); *Guide to the Christy Collection of Prehistoric Antiquities and Ethnography* (1868); *Catalogue of a Collection of Oriental Porcelain and Pottery* (1876); and edited *Horæ Ferales* (1863) and *Japanese Pottery* (1880). He was a fellow of the Society of Antiquaries, and was its president from 1892 till his death, May 22, 1897.

Franqueville, AMABLE-CHARLES FRANQUET, Comte de: French jurist and politician; b. in Paris in 1840; studied law and was admitted to the bar in Paris, and afterward, under the empire, was an auditor in the Council of State; in 1888 was made a member of the Academy of Sciences; was made an officer of the Legion of Honor May 17, 1873. His most important works are analytical studies of English institutions, including *Étude sur les sociétés de secours mutuels d'Angleterre* (1863); *Les Institutions politiques, judiciaires, et administratives de l'Angleterre* (1864); *Du Régime des travaux publics en Angleterre* (1875); *De la Personnalité civile du diocèse* (1875); *Le Gouvernement et le Parlement britanniques* (1887). F. STURGES ALLEN.

Franz Josef Land: an Arctic archipelago lying mostly N. of the eightieth parallel and bisected by the meridian of 60° E. lon. It consists of islands whose number and size are still undetermined, though most of them are small, and there is reason to believe that none compares in size with the main islands of the Spitzbergen group, which they resemble in geological structure and in their general aspect, though, being farther N., their climatic conditions are more severe. There are no mountain-chains, but there are many conical or table-topped mountains, isolated and in groups, with a mean altitude of 2,000 to 3,000 feet. The rocks are largely of igneous origin, though sandstone and old marine beds strewn with shells are found. The vegetation is not rich, and no reindeer have been met, but other Arctic land-animals and birds and sea-animals abound. The group was discovered by the Austro-Hungarian expedition commanded by Carl Weyprecht and Julius Payer, in the ship Tegetthof, on Aug. 30, 1873. They were borne to the islands by the ice-pack, their vessel drifting more than ten months before they saw these new lands. Payer's sledge journey in the spring of 1874 extended to Cape Fligely, 82° 5′ N. and 58° E., and resulted in a map of the archipelago, which has since been greatly changed by the explorations of Leigh Smith in 1880 and 1881, who extended the limits of the archipelago to the N. W., and by the Jackson-Harmsworth expedition, which spent about three years among the islands from Sept. 7, 1894. The main geographical result of the last expedition was the proof that the islands do not extend far to the N., and therefore do not afford, as was conjectured, a convenient land base for sledging toward or to the pole. C. C. ADAMS.

Frederic, HAROLD: journalist and novelist; b. in Utica, N. Y., Aug. 19, 1856; graduated at Hamilton College in his twentieth year; in 1874 became a proof-reader in the office of the Utica *Herald*, and during the next six years was rapidly advanced on the staff of that paper, and became chief editor of the Utica *Observer*; in 1882 assumed charge of the Albany *Evening Journal*, and edited it for two years; in 1884 was sent to London as regular correspondent of the New York *Times*, and remained at that post until his death. Aside from his pronounced success as a journalist, he achieved distinction as a writer of fiction. His first novel, *Seth's Brother's Wife* (1887), won for him creditable position; this was followed by *In the Valley* (1889); *The Lawton Girl* (1890); *The Return of the O'Mahony* (1892); *The Copperhead* (1894); *Marsena* (1895); *The Damnation of Theron Ware* (1896); and *March Hares* (1896). *Gloria Mundi* was running serially at the time of his death. It was his aim to illustrate in his fiction the peculiar features of American life. *The Damnation of Theron Ware* is generally regarded as his most truthful and powerful work, *March Hares* coming next. D. in London, England, Oct. 19, 1898.

Free Ports: A certain area in a number of important ports of Europe, specially reserved, is called the "free port," and within its limits all goods may be landed or stored without paying duty. The whole area, with all trading and manufacturing establishments in it, is considered as "foreign territory," not subject to customs duties or regulations until goods stored or manufactured within the free port are actually sold to persons in the same country, when the goods are treated as other imported wares. Thus at Hamburg, Bremen, and Copenhagen, the three chief free ports, commodities may be brought from any part of the world into the area set apart as the free port and then sent to foreign markets, paying duty only when taken into the country in which the free port is situated. The advantages of the free port to commerce are similar in many respects to those of bonded warehouses in the U. S. Lumber may be shipped to the free port of Copenhagen, stored there at low rates, and then distributed to the various ports of the Baltic according to the demands of trade without paying customs duty unless sold for use in Denmark. The tendency of the free port is to enhance the importance of the port by making it a central emporium for commodities brought from afar to be finally distributed in other countries. Imports stored in the free ports of Hamburg and Bremen are distributed to all parts of the world. C. C. Adams.

French, Daniel Chester: sculptor; b. in Exeter, N. H., Apr. 20, 1850. He studied art in Boston and in Florence, Italy; opened a studio in Washington, D. C., in 1876, and there executed *The Owl in Love* and *Dick Swiveller and the Marchioness*; returned to Florence in 1878, and afterward resided there. His sculptures include *The Minuteman of Concord* (unveiled in Concord 1875); *The May Queen*; *Elsie Venner*; *Peace and War* (in the St. Louis custom-house); *The Waking of Endymion*; and a life-size statue of Gen. Lewis Cass (for the National Memorial Gallery, Washington).

French, George Franklin: physician; b. in Dover, N. H., Oct. 30, 1837; graduated at Harvard College in 1859, and at its medical school in 1862; served on the staff of Gen. Grant and organized field hospitals for Gen. Sherman's army in the civil war; was surgeon-in-chief under Gen. Sherman during the march to the sea, and resigned in June, 1865. He settled in Portland, Me., was one of the original staff of the Marine General Hospital, and in 1875 became instructor in physiology and lecturer on dermatology in Portland Medical School. He went to Minneapolis in 1879, was lecturer on obstetrics in the St. Paul Medical College in 1881 and in the Minneapolis Hospital College 1882–85, and in 1886 became Professor of Gynæcology in the last-named college. He was president of the State examination board in 1887, and president of the Minnesota Academy of Medicine in 1890. D. in Minneapolis, July 13, 1897.

French, John Raymond, LL. D.: educator; b. in Pulaski, Oswego co., N. Y., April 21, 1825: graduated at Union College in 1849, soon afterward becoming Professor of Mathematics in Falley Seminary, Fulton, N. Y., of which he was subsequently principal; in 1855–59 was principal of Mexico Academy; during this time he studied law, in 1859 was admitted to the bar, and practiced until 1864, when he became Professor of Mathematics at Genesee College. When Genesee College became Syracuse University, in 1871, Dr. French was made dean of the College of Liberal Arts and retained the chair of Mathematics; at the time of his death, Apr. 26, 1897, he had been for nearly three years vice-chancellor of the university. He received the degree of LL. D. from Allegheny College in 1870.

Friedheim, Arthur: pianist; b. in St. Petersburg, of German parents, Oct. 26, 1859; studied there, and made his first appearance in his ninth year. Then, with his mother, he went to Weimar, where he became a pupil of Liszt. Next he went to Dresden and conducted opera there for several years, but afterward returned to Weimar, where he took up his abode with Liszt, accompanying that great master to Rome and Naples. He made several concert tours, with great success, through Cairo, Alexandria, Vienna, Northern Germany, Paris, and London. In 1891 he came to New York. Among his compositions is a concerto for piano in B flat, which he first brought out in Carlsruhe, Nov. 30, 1891, and again in New York, in Mar., 1894. D. E. Hervey.

Friedrich, Johannes, D. D.: Old Catholic theologian; b. in Poxdorf, Bavaria, not far from Bayreuth, May 5, 1836; studied at the Universities of Bamberg and Munich; was ordained to the Roman Catholic priesthood in 1859, and became chaplain in Marktscheinfeld, Bavaria. His academic activity began in 1862, when he became privat docent in the University of Munich; in 1865 he was made Professor Extraordinary of Theology. In 1869–70 he attended the Vatican Council as "theologian" to Cardinal Prince Hohenlohe-Schillingsfurst, and made himself very obnoxious to the majority by joining his colleague Döllinger in opposing the passage of the papal infallibility dogma. When, in 1871, Archbishop Scherr, of Munich-Freising, demanded acceptance of this dogma from all members of the Munich theological faculty, he, with Döllinger, refused and was excommunicated. Nevertheless, he was promoted to the ordinary professorship of Doctrinal History, Symbolics, Patrology, and Ecclesiastical Archæology and Literature in 1872. In 1882 the feelings of the strict Catholics were respected, and he was transferred to the philosophical faculty as Ordinary Professor of History. He took a prominent part in organizing the Old Catholic Church, opened the Old Catholic theological faculty at Bern in 1874, and lectured there two semesters on church history; yet when the Old Catholic synod voted, in 1878, to allow its priesthood to marry, he consistently withdrew from its leadership. He has been a prolific author. Of especial interest are his writings on the Vatican Council, *Tagebuch während des vaticanischen Concils geführt* (Nördlingen, 1871; 2d ed. 1873); *Zur Vertheidigung meines Tagebuch* (1872); *Geschichte des Vaticanischen Concils* (Bonn, 1877–87, 3 vols.); and his biography of Döllinger (Munich, 1st vol. 1899). S. M. J.

Fry, Sir Edward, P. C., B. A., D. C. L., LL. D., F. R. S., F. S. A., F. L. S.: jurist; b. in Bristol, England, Nov. 4, 1827; educated at Bristol College and at University College, London, and is a fellow of University College and of Baliol College, Oxford University; was called to the bar in 1854 and made queen's counsel and bencher of Lincoln's Inn in 1869, and was appointed treasurer of Lincoln's Inn in 1892. He has held many positions of trust, including the governorship of the Charterhouse and of Clifton College, trusteeship of the Hunterian Museum, College of Surgeons, etc.: presided over the royal commission on the Irish Land Acts 1897–98; was knighted in 1877, in which year he was made judge of the High Court, Chancery Division, which office he held until 1883, when he was appointed a lord justice of appeal, from which latter office he retired in 1893. He has published *Essays on the Accordance of Christianity with the Nature of Man* (1857) and *A Treatise on the Specific Performance of Contracts* (3d ed. 1892). He is an enthusiastic student of bryology, and has published a book on *British Mosses* (1892). F. Sturges Allen.

Funcke, Otto: German Protestant popular preacher; b. in Wülfrath, Germany, Mar. 9, 1836. He studied at Halle, Tübingen, and Bonn, and since 1868 has been pastor of the Friedenskirche in Bremen. His religious writings are very popular. Several of them have been translated: *The School of Life: Life Pictures from the Book of Jonah* (London and New York, 1885; 2d ed. 1886); *Self-will and God's Will, or How to Discern what is God's Will in the Perplexing Questions of Life* (1887); *The World of Faith and the Every-day World, as displayed in the Footsteps of Abraham* (1891); *How to be Happy and to Make Others Happy* (1896). S. M. J.

Funk, Franz Xaver, von, D. D.: Roman Catholic theologian; b. in Abts-Gmünd, Würtemberg, Oct. 12, 1840; studied at Tübingen and in the priests' seminary at Rottenburg; became Professor Extraordinary of Theology at Tübingen 1870; Ordinary 1875; was ennobled 1890. Of his learned works may be mentioned *Geschichte des kirchlichen Zinsverbotes* (Tübingen, 1876); *Lehrbuch des Kirchengeschichte* (Rottenburg, 1886; 3d ed. 1898); *Die apostolichen Constitutionen* (1891); *Kirchengeschichtliche Abhandlungen und Untersuchungen* (Paderborn, vol. i., 1897). He edited the fifth edition of Hefele's *Opera patrum apostolicorum* (1878–81, 2 vols.; 2d ed., vol. i., 1887). S. M. J.

Funk, Isaac Kaufmann, D. D., LL. D.: b. in Clifton, O., Sept. 10, 1839: graduated at Wittenberg College, O.; held pastorates near Moreshill, Ind., at Carey, O., and in Brooklyn, N. Y., 1860–65; traveled in the Holy Land, Egypt, and Europe in 1872, and on his return engaged in the publishing business; founded and edited the *Metropolitan Pulpit* (now the *Homiletic Review*) in 1876. The firm of which he is the head founded *The Voice*, a Prohibition paper, in 1884, and *The Literary Digest* in 1890; it has also published a number of important reference books, its principal publication being the *Standard Dictionary* (1890–94), of which he was editor-in-chief. He is an aggressive Prohibitionist, and is prominent in other social reforms.

Fursch-Madi, Emma: singer; b. in Bayonne, France, about 1847, and was educated at the Paris Conservatory. Her first public appearance was at a symphony concert conducted by Pasdeloup. Next she appeared as Marguerite, in *Faust*. Verdi selected her to create the part of Aïda in French at the Théâtre de la Monnaie, Brussels. Her first visit to the U. S. was in 1874, with the New Orleans French Opera Company. Returning to Europe, she sang for three seasons in Covent Garden, London, with such success that Mapleson engaged her for the New York season in 1884 at the Academy of Music. She was engaged by Henry E. Abbey for the opening season of the Metropolitan Opera-house. She sang frequently in opera and concert, until, taken ill, she bought a farm in Warrenville, Somerset co., N. J., and retired to it, where she died, Sept. 19, 1894. She was married three times—first to M. Madier de Montjau, next to M. Henri Verle, and finally to Mr. Wurtz, a painter. She left a son by her first husband and a daughter by her second. Her last public appearance was as Ortrud, in *Lohengrin*, at the Metropolitan Opera-house, in Feb. 1894.
D. E. Hervey.

Furst, William: composer and conductor; b. in Baltimore, Md., Mar. 25, 1852, and studied music there. At the age of fourteen he was a church organist. In 1878 he produced his comic opera *Electric Light*, and then conducted an opera company for five seasons. In 1884 he went to San Francisco, and became musical director of the Tivoli theater. There his opera *She* was brought out and ran for nine weeks. It was also given in New York, at Niblo's, Dec., 1887, and performed two seasons. In 1888 his grand opera *Theodora* ran for four weeks in San Francisco. Other works are *The Isle of Champagne* (1891); *Honeymooners* (1893); *Princess Nicotine* (1893); *The Little Trooper* (1894); *Ghismonda*, incidental music (1894); *The Merry World* (1895).
D. E. Hervey.

END OF VOLUME FOUR.